AMERICAN MACHINIST

JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 13, No. 15. WEEKLY. | NEW YORK, THURSDAY, APRIL 10, 1890. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

COPYRIGHT 1890, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

A Method of Extending the Range of Cut-off and Compression in Corliss Engines.

BY JAMES B. STANWOOD.

The narrow range of cut-off and the small amount of compression that have been obtained by the Corliss valve gear are perhaps its weakest characteristics.

With it the latest cut-off and greatest compression have been so related that one can be extended only by a corresponding diminution of the other. Though the limits to these functions are narrow, yet they have been adjusted to embrace, for simple engines, the most economical conditions as to expansion, and admit of sufficient compression for smooth running at ordinary speeds.

The relation existing between these two vital points of this famous gear we will consider somewhat in detail, as it will be of value to a clearer understanding of the modification by which both can be increased.

With a single eccentric releasing gear, the eccentric controls four important points in the movement of the valves, viz., the lead, the point of maximum cut-off, the release and the compression. Figs. 1, 2, 3 and 4 show the relative positions of crank and eccentric corresponding to these four vital points. The proportions here shown are what are usually found in practice; thus the angular advance of eccentric is 15°; lead angle, 6°; exhaust lead angle, 9°; these give piston positions (angularity of connecting rod neglected) as follows: Latest point of cut-off (by releasing gear) $\frac{87}{100} = A\ B$ (Fig. 2), release $\frac{99}{100}$ (Fig. 3), compression $\frac{96}{100} = A\ B$ (Fig. 4).

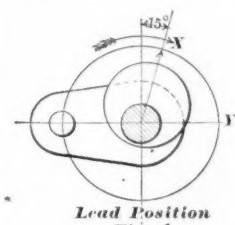
It is well known that the maximum cut-off controlled by the governor takes place when the eccentric is at the extreme position of its travel, and depends upon the angle through which it revolves from a position corresponding to that of the crank when at its dead center or to an angle subtended by the arc $X\ Y$ (Fig. 1) equal to $A\ Z$ (Fig. 2) equal to 90° angular advance of eccentric.

If more compression is required it can only be obtained with same exhaust opening, by giving the eccentric more angular advance; this reduces the angle subtended by the arc $X\ Y$ (Fig. 1) $= A\ Z$ (Fig. 2), which in turn reduces the time during which cut-off can act. Table I. (page 2) indicates the amount of compression, and the corresponding limit for cut-off for varying angular advances of eccentric.

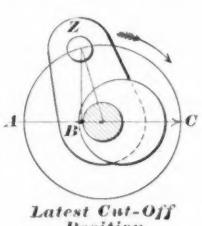
As the angularity of the connecting rod increases the range of cut-off at one end of cylinder and decreases it at the other, Table II. is given to show this effect for different ratios between connecting rod and crank; the minimum value in each case is given, as in practice the cut-off is adjusted to be the same on either end of the cylinder, and consequently cannot be greater than the lesser maximum amount.

These tables show conclusively the narrow limits imposed by this gear. With the advance toward compounding, and with the constant effort to maintain higher piston speeds, greater range is needed. For instance, in double and triple expansion engines, large mean effective pressures, and the advantage of low range of temperature in each cylinder, in combination with high number of expansions, requires later cut-offs; or, again, in simple engines with Corliss gear of light loads "show up"; with a greater range of cut-off, the maximum power being increased, smaller cylinders can be used, and a more economical adjustment of expansions to load at all times obtained.

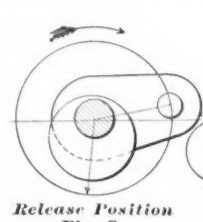
The advantages of greater compression are well known, but may be briefly stated; by preventing pounding it assists in maintaining higher rotative speed, especially on condensing engines, simple and compound. This higher rotative speed in turn reduces cylinder condensation, and also permits of more power being obtained from a given cylinder. Compression also assists in filling clearance spaces with steam economically.



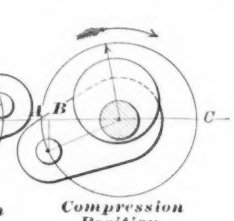
Lead Position
Fig. 1.



Latest Cut-Off Position
Fig. 2.



Release Position
Fig. 3.



Compression Position
Fig. 4.

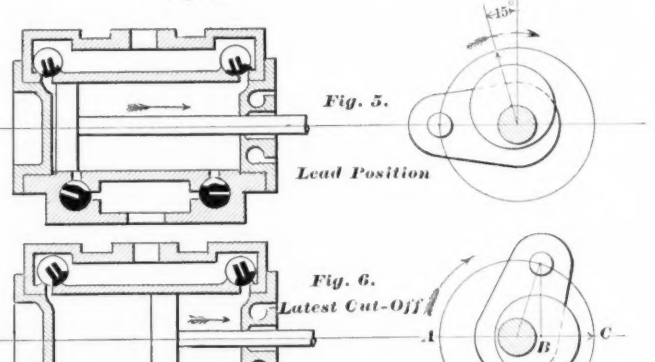


Fig. 5.
Lead Position

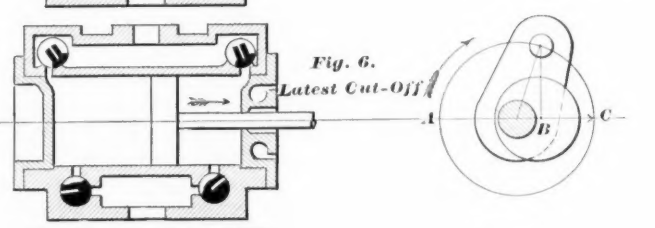


Fig. 6.
Latest Cut-Off

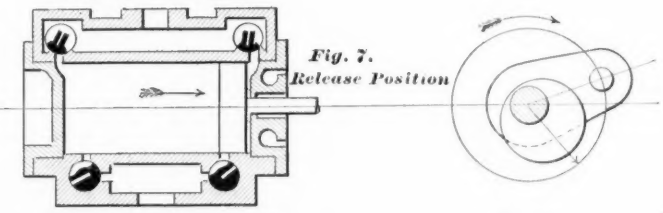


Fig. 7.
Release Position

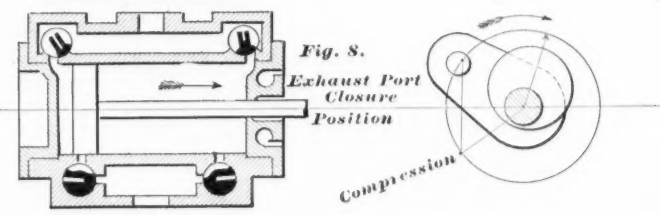


Fig. 8.
Exhaust Port Closure Position
Compression

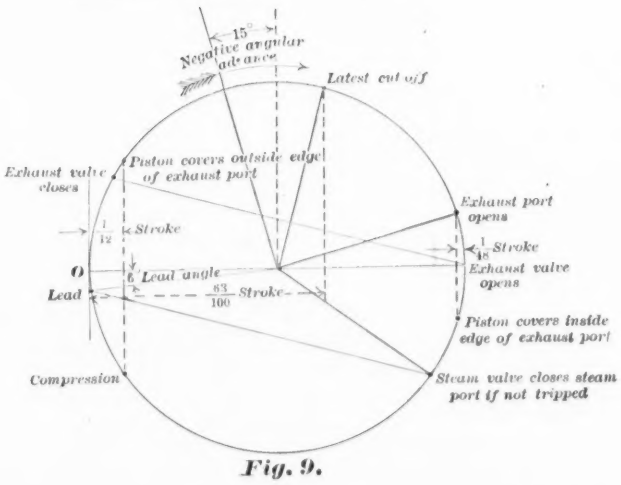


Fig. 9.

These features indicate the advantages to be derived from any system of extending the range of the Corliss valve gear. In England manufacturers of these engines use double eccentrics and double wrist plates, one system operating the steam valves, the other the exhaust valves; by this separation any cut-off can be obtained as well as any amount of compression, but at the cost of greater complexity of mechanism The system to be described to accomplish the same result has no mechanism other than the usual Corliss gear, with its single eccentric, wrist plate, tripping devices and dash-pots; yet, by a modification of construction of the cylinder, its range of cut-off is increased to a greater extent, with an accompanying increase in compression.*

This is brought about by removing the immediate control of both the compression and release from the eccentric, and in handing it over to the piston of the engine itself. When this is done, the eccentric freed from these duties has only the point of lead to determine, and can be adjusted on shaft in a position that will give a large range of cut-off.

To explain more in detail: Fig. 5 shows a steam cylinder in which the exhaust ports are placed within the limit of the piston's stroke; by allowing the piston to pass over these ports, compression is obtained to any required amount; we shall directly see what latitude it gives to the valve motion. By proportioning the piston head of suitable thickness, it can be made to uncover the exhaust port on its back edge in such a manner as to permit release to occur at the correct time. To successfully carry out these duties certain conditions are imposed upon the exhaust valves; but fortunately they bear such relations to the eccentric's position on the shaft as to permit it to have *negative angular advance*—the requirement for all releasing gear cut-offs acting later than half stroke. These conditions are two-fold: first, the closure of the exhaust valve should be complete before the piston, under the action of incoming steam, has uncovered the exhaust port; second, the exhaust valve at opposite end of cylinder should be wide enough open to permit easy egress of steam at the instant the piston on its inner edge closes the other port opened previously for preliminary release.

The eccentric has now, as in the usual gear, four points to control, but they occur at different intervals of time than before. They are, viz., the lead, the limit to cut-off, the opening of release at proper time on *return* stroke and the closure of exhaust port before piston uncovers same on its *forward stroke*. Figs. 5, 6, 7 and 8 show these four positions for eccentric and crank, Figs. 5 and 6 showing clearly the increased range of cut-off secured by negative angular advance. Observe what is obtained by this arrangement—the cut-off can occur anywhere between A and B, Fig. 6; the exhaust valve begins to open the instant the crank is at end of stroke; it has no lead, but steam has been released some few degrees before (Fig. 7) when piston on back edge uncovered the exhaust port; when it closes same on returning, the exhaust valve is well open, as the eccentric during this period has its maximum motion. The compression begins at the instant piston covers port as it approaches the end of its travel; the exhaust valve is not closed until just before piston uncovers this port (Fig. 8) when starting out again on a new stroke. The maximum cut-off is $\frac{63}{100}$ stroke, the exhaust opens at $\frac{97}{100}$ stroke, and compression begins at $\frac{99}{100}$ stroke. By Prof. Sweet's valve diagram (Fig. 9) the whole operation is shown at once. In this case the lead angle is 6°, angular advance (negative), 15°, exhaust lead angle (by eccentric), 0°.

The fact that the exhaust valves have to

[*We believe this system is patented.—Ed.]

be closed before the piston, at beginning of each stroke, shall uncover the exhaust ports, determines a minimum distance that such a port shall be placed from end of cylinder for any given negative angular advance of eccentric; this distance determines the amount of minimum compression. For the purpose of showing the relation that exists between this minimum amount of compression and varying amounts of negative angular advance, Table III. has been calculated; it also gives the corresponding latest points of cut-off.

The angularity of the connecting rod with this, as with all other valve gears, causes an interference which reduces the maximum limit for cut-off. Table IV. shows what the practically obtainable points are for varying ratios of connecting rod to crank. Tables I. and II. should be compared with Tables III. and IV., to give an idea of gain in both cut-off range and amounts of compression of new over old system. It should be remembered that the values for latest cut-offs given in these tables are in reality the piston positions when the cut-off valves are tripped; the actual cut-off occurs slightly later, as there is an appreciable amount of time occupied in closing the port during the fall of dash pots, the piston all the while traveling on under steam.

Below is given a comparison of two practical cases of the two systems of valve gear, with positive and negative angular advance:

Angular Advance	Maximum Compression (Latest Cut-off)	Angularity of Con. Rod Neglected (Latest Cut-off)	Ratio of Con. Rod to Crank. 5 to 1 (Latest Cut-off)	Ratio of Con. Rod to Crank. 6 to 1 (Latest Cut-off)
15°	.967	.37	.27	.29
Negative Angular Advance	**Minimum Compression**			
15°	.933	.63	.53	.55

LATEST CUT-OFF AND COMPRESSION FOR VARYING ANGULAR ADVANCE.

Lead Angle = 6°, Exhaust Lead Angle = 9°.

Table I. Angularity of Connecting Rod Neglected. Table II. Latest Cut-offs for Varying Ratios of Connecting Rod to Crank.

Angular Advance.	Greatest Compression.	Latest Cut-off.	4 to 1	4½ to 1	5 to 1	5½ to 1	6 to 1
5°	.999	.46	.33	.34	.36	.37	.38
8°	.996	.43	.31	.32	.33	.34	.35
10°	.991	.41	.29	.30	.31	.32	.33
12°	.983	.40	.28	.29	.30	.31	.32
15°	.967	.37	.25	.26	.27	.28	.29
18°	.946	.35	.23	.25	.26	.27	.27
20°	.929	.33	.22	.23	.24	.25	.26
22°	.910	.31	.20	.21	.22	.23	.24
25°	.877	.29	.18	.20	.21	.22	.22
28°	.841	.27	.17	.18	.19	.20	.20
30°	.815	.25	.16	.16	.17	.18	.18
32°	.787	.23	.14	.15	.16	.16	.17

LATEST CUT-OFF AND MINIMUM COMPRESSION FOR VARYING NEGATIVE ANGULAR ADVANCE.

Lead Angle = 6°, Exhaust Lead Angle = 0°.

Table III. Angularity of Connecting Rod Neglected. Table IV. Latest Cut-offs for Varying Ratios of Connecting Rod to Crank.

Negative Angular Advance.	Minimum Compression.	Latest Cut-off.	4 to 1	4½ to 1	5 to 1	5½ to 1	6 to 1
5°	.992	.54	.41	.42	.44	.45	.46
8°	.981	.57	.45	.46	.47	.48	.49
10°	.970	.59	.47	.48	.49	.50	.51
12°	.957	.60	.48	.49	.50	.51	.52
15°	.933	.63	.51	.52	.53	.54	.55
18°	.905	.65	.53	.55	.56	.57	.57
20°	.883	.67	.56	.57	.58	.59	.60
22°	.860	.69	.58	.59	.60	.61	.62
25°	.821	.71	.60	.62	.63	.64	.64
28°	.779	.73	.63	.64	.65	.66	.66
30°	.750	.75	.66	.66	.67	.68	.68
32°	.719	.77	.68	.69	.70	.70	.71

The vessels launched from the shipbuilding yards on the Clyde in February of this year aggregated 38,192 tons; in February 1889, 17,740 tons; and in the corresponding month in 1888, 5,250 tons.

Practical Details of Blacksmithing.

By B. F. Spalding.

BENDING IRON—NEUTRAL LINE OF FLEXURE—CHANGES OF STRUCTURE IN BENDING—NO ABSOLUTE UNIVERSAL RULE TO CALCULATE LENGTH—CHANGE OF POSITION OF NEUTRAL LINE—EFFECT OF UNEVEN QUALITY—OF CHECKS—DETECTION OF CHECKS IN STEEL BLADES.

It would very materially assist the blacksmith in making his calculations, in many instances, if he had some certain rule of general application, by which he could determine with unfailing accuracy the neutral line in a bar of iron, which is to be bent, about which all the changes which may take place in bending, will occur while through all the mutability of form it undergoes, it will still, with strict integrity, retain its length. If such were the case, it would then be possible for him to measure a circle, and cut off a piece of the required sized iron, obliquely to a bevel set to the radial line, and bend the iron over a mandrel of the required size, with a positive assurance that, when his two cut surfaces came together, the circle would be of the required diameter. This is a feat which he cannot now with absolute certainty perform, even after he has made some preliminary experiments.

When a piece of iron is bent, the convex side stretches, and the concave side is compressed, in consequence of which, the outer or convex side gets thinner, and the inner or concave side thicker. Now, allowing that this bar of iron is homogeneous in structure, and uniform in size, and further, that the resistance to compression and to tension are equal, then the part outside of a medial line will stretch, and that inside of the line will congest with equal facility when the pressure is first brought to bear to bend the bar, then the neutral line of flexion dividing the two stresses; that is, the line outside of which the stock is being stretched, and inside of which it is being compressed, must run along in the center of the bar, as shown in Fig. 1. But at the instant the operation commences, and as long as it continues, the dimensions of the bar are being altered. It comes to be no longer of uniform dimensions; the thickness of the concave side is increased, while that of the convex side is decreased—see cross-section of bar, Fig. 2; the dotted lines indicate the change which takes place. Then as resistance to change in the position of particles increases as they mass together, and decreases as they are dispersed—as the thicker the inside grows, the harder it is to be compressed, and as the thinner the outside becomes, the easier it is to be stretched—it is evident that, while these changes take place in the relative resistance of the sides of the bar, the line of flexion must move towards the concave side—see dotted line, Figs. 1 and 2—with a movement, which is accelerated as the difference in the sides is increased.

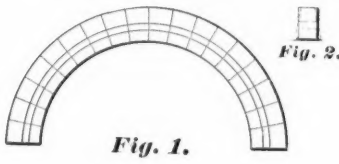


Fig. 1.

Fig. 2.

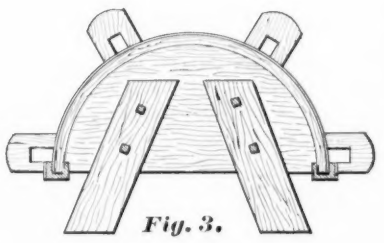


Fig. 3.

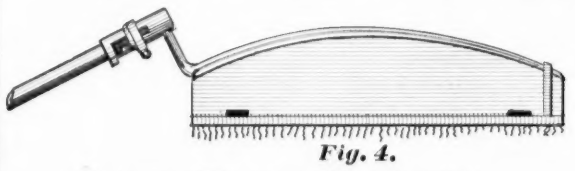


Fig. 4.

Practical Details of Blacksmithing.

It is obvious that, in two circles of different diameters, this line in the bar must be nearer the center of the circle in the smaller, because, after the stock has been bent to the curve of the larger, and has by this operation been thickened up on one edge, and thinned on the other, it will stretch easier on the thinner outside, and upset harder on the thicker inside, in bending beyond this shape, than in the bending it has already undergone.

It is evident, therefore, that if, by a number of experiments, the position of the neutral line could be determined in bars of uniform size, which were required to be bent to conform to the larger circle, it could not be fixed in the same place on bars of the same size, if they were to be bent to a smaller circle. The fact that it varies, as it does, in different curves, and also with the thickness of the stock which is used, would be sufficient reason, even if there were no other circumstances to be considered, why no fixed rule can be given to determine arbitrarily in all cases the position of the line of flexion.

When experiment has so far determined a matter, that the results of definite modes of treatment can be predicted with certainty, and the laws which govern the action have thus been ascertained, then a formula—a concise statement of the accepted facts of cause and effect—can be laid down, which may be safely followed. This has always been the case in all trades, to a greater or less extent, however much it has been supplemented by the rule of thumb. The advantages thus derived have become so manifest that the practice, extending in every direction, is fitted to every possible, and sometimes impossible use. Thus the results of experience are epitomized, shorn of extraneous and superfluous circumstance, and made directly applicable to any case in point. There are, however, so many things which may affect results, that, with all the accuracy of scientific data, there are few occasions when all, and every single one, of the circumstances which may have a near or remote bearing exactly coincide. Whoever depends upon scientific formula needs be certain that there is sufficient guess-work thrown in, to insure the element of safety in each particular case. So, in an instance which so frequently occurs, as the cutting off of a piece of iron to make a round hoop of a specific size, there are apt to be so many uncertainties about it, that no absolutely inflexible rule will fit in every case. A great many blacksmiths find this out, but suppose they must be mistaken about it. They think the fault is in themselves; they suppose there must be such a rule, but that, unfortunately, they individually either do not know it, or do not work it right. The old rule is: Add the thickness of the stock to the inside diameter of the ring, multiply the amount by 22, divide the product by 7, and add to the quotient thus obtained, the thickness of the stock.

$$\frac{(\text{Inside dia.} + \text{thickness}) \times 22}{7} + \text{thickness} = \text{length.}$$

When this rule is examined, it will be found to be the same thing, in effect, as taking the measure of the ring from center to center of the stock of which it is made, and multiplying it by $3\frac{1}{7}$, or, as decimally expressed, 3.1428, which, in forging, is a close approximation to 3.1416, and this practice assumes that the iron bends on the central line. The addition of length equal to the thickness of the iron is to supply the extra amount needed in welding with a lap weld, and allows sufficient to upset the ends enough to leave the stock about the weld, up full to size.

As blacksmiths discover that the line of flexure is seldom in the center of the bar, and as some workmen require less stock to make a weld than others, they generally modify the formula given above, to suit circumstances, making such allowances as their judgment dictates; and, if they fall into error—as the very best are liable to do at times—the resources of their trade enable them to rectify it, and thus overcome the difficulties arising from the uncertainties mentioned. It is always best to have plenty of stock at the weld, and to round up and measure the ring as soon as the weld is thoroughly made. It is not always an easy matter to upset a ring; and rings, small in proportion to the size of stock, are not easily stretched. If, after the ring is rounded, it is found to be large enough, the extra stock at the weld can be removed with the chisel, and if it is not large enough the extra stock can be hammered into it, to enlarge it to the required size, chubby rings requiring to be forced on a mandrel while doing so. If properly heated, neither iron nor steel suffer injury from being well hammered.

The making of a plain hoop of iron, of any size, is only one of the most simple instances of the difficulties which are met with in bending iron, on account of the change which takes place in the position of the bending line. A process which illustrates very forcibly the manner and circumstances, by which the position of this line may sometimes be changed, is that which has been in use for a number of years in bending thick wooden felloes, or rims for wheels.

A manufacturing concern had a lot of wheels to make, some three feet in diameter. The rims, 7″ wide, and 2″ thick, were to be bent in half circles. They were steamed, and bent over "formers," but the thickness was so great that the steaming was not efficacious in preventing them from splintering on the outer side, the strain separating the fibers. On a half circle of this size, supposing the line of flexure to be in the center of the stock, the outside would have to stretch some 3″, or about $\frac{1}{16}$″ to each inch. This was more than it could endure, and all attempts to bend them satisfactorily proved futile, until the proprietors, who had on previous occasions bought them all bent in good shape, from a wheel factory in a neighboring city, concluded there was some secret about it which they had not discovered. No one was allowed to visit the department of the wheel factory where they were bent, but a small order was placed there for wheels, and, while it was being executed, one of the proprietors, managing in some way to gain admittance to the works, discovered the manner in which the process was conducted, and after returning home put it into successful operation. To do so the pieces of wood were all sawed off to the length of the outside circle, and when a piece was steamed, each end of it was fitted into a clamp, and these two clamps were bound together by a sheet steel strap of the same width and length as the wood. The whole thing was now bent over the former, as shown in Fig. 3. The sheet steel prevented the outside from stretching or being strained, and the line of flexion was by this means removed from the center of the wood to the outer side.

This change made the inside shorten up the whole of the six inches difference between the inner and outer curves, congesting it so that it crinkled. This is not given as an example in ethics, but in technics.

The manner in which the rims were bent shows very clearly that any inequality in the hardness of the inner and outer portions of stock, whether produced by uneven heating or by variation of quality, making either one side or the other of the center stiffer, will cause a difference in the length of the piece which is bent.

It is evident that this tendency will manifest itself more in bending a piece of flat iron edgewise, than in bending it flatwise, because there will be more difference in the lengths of the outer and inner curves. Some iron is harder in quality on one side than on the other, and some iron is less coherent on one side, being full of fine checks. Taking two pieces of the latter $1\frac{1}{4} \times \frac{1}{4}$″, and bending both edgewise into rings a foot in diameter, one having the checks outside, and the other inside, the first will often be found to be an inch longer than the other, and still exhibit but slight opening of the checks. "Many littles make a mickle." If there are 10 checks to an inch, and each one

opens .003″, not enough to admit the entrance of an edge of this printed sheet, yet it would amount to .03″ to each inch, and to 1.08″ in 36″, and when the circle was to be bent of such iron as this, who could predict where the neutral line would be?

Checks as large as these are met with quite often in the general run of low-priced merchant iron. They are here spoken of only in a relative sense as being fine; they would be considered so only on rough forged work, not intended to be finished. It is, of course, not expected that such stock would be tolerated for finished work, but even in the most important finished work, checks are frequently met with. Swords and bayonets are tested for checks so fine as to be invisible to the naked eye. Swords are bent over a circle of 35″ in diameter. The bayonet is bent over a circle as seen in Fig. 4, and while in this position the strained surface is wiped over with oil, and while still bent it is wiped perfectly clean with clean waste. The strain is then released, and the blade straightens out. Now the oil is visible to sharp eyes in the finest imaginable lines, which are nothing more nor less than indications of microscopic checks, into which the oil found ingress when they were strained open, and from which it exuded when squeezed by the closing up of the checks when the tension was released. The exercise of some judgment is required in the inspector to reject those blades which are seriously affected. It is found that, when submitted to this severe test, surfaces which otherwise appear perfectly smooth disclose innumerable breaks in their continuity. There are also such things as "blind" checks; the surface will be sound, but minute indentations indicate breaks beneath. If this is the case with stock which is worked with all possible skill and caution, it is not incredible that our ordinary stock is affected to a greater extent than is generally supposed, and, even when the checks are not themselves visible, their effects are manifested in the irregular bending of iron.

"Tapers."—Reply to "A Mechanic."

BY JARNO.

In the AMERICAN MACHINIST of Feb. 20th, "A Mechanic" has a letter on "Interchangeable Lathe Centers," a portion of which is in answer to me on the subject of tapers; to this portion I will now reply.

He does not agree with me; in fact, between him and myself the difference of opinion is fundamental, and, in consequence, between us there can be no argument. All reasoning must start from the known, and an argument can have no weight with one that does not believe the basis upon which it begins. He says that there is nothing to be gained by having lathe centers interchange, and that it is impracticable to make them interchangeable.

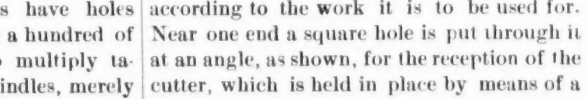
After such a balance of testimony, we cannot decide until we have more witnesses. Of these there are many that will attest the correctness of my opinion; it will be enough to present two.

Having read in the AMERICAN MACHINIST that F. E. Reed had received the largest single order for lathes that was ever given, I considered him a representative maker, and I asked whether he would give me his practice in regard to spindle holes, and permission to quote. He kindly gave both, and also a tracing showing his system of tapers. I am pleased to note that all his tapers are of the same rate as the Jarno, one in twenty, and that several are, in diameter and length, very near to some of the Jarno numbers. The Jarno No. 8 can be used in his 16″ swing engine lathes. Of this size he has made nearly five hundred, in all of which the centers are interchangeable. With proper tools he has found no trouble in making spindles and centers in this way. He thinks it also an advantage to finish centers throughout, and keep them in stock ready for assembling, the same as he does other lathe parts, which he will shortly be prepared to do more completely.

Mr. Reed adopted the one in twenty taper, years before I thought of it. I chose it without knowing that he had already done so. I am encouraged to think that, upon careful consideration, others will adopt the same rate.

The head of a machine shop knows the general character of its product. In addition, it is interesting to hear from a man that, with his own hands, has tried spindles by the standard. Such a man is J. S Waterman, a former student under Prof. Sweet, and a practical machinist. Mr. Waterman says that he has tried hundred of holes by the same standard, and that each hole was practically a good fit. "A Mechanic" is right in saying that to turn a standard clear around does not give a good test of the hole. Mr. Waterman puts a thin film of coloring matter on the standard, and moves it through only four or five degrees. Unless "A Mechanic" brings a witness, whose evidence will offset that of my witnesses, I shall have better reasons than he for holding to my opinion. I think he will find difficulty in getting an extensive lathe maker to admit that it is both useless and impracticable to have spindle holes alike. A maker might send out a multiplicity of tapers; but to make a statement to that effect would not be to his interest.

"A Mechanic" may be also a machinist, but his letter contains no internal evidence that he has ever made two or more spindles at a time, by the approved method indicated in the figure; for, if he had, he would have learned that, even in the making, it is better to have the holes alike. If reamed never so little, even though turned or bored with a single point tool, it is not expected that the hole *H* will be true. After reaming, the test arbor *T* is put into the taper hole, and the position of the center hole *C* is changed until the test arbor runs true, when the combined arbor and spindle are rotated on the centers *D* and *C*. This operation is called "picking up the center." After the centers are picked up, the test arbor is replaced by a short arbor or plug, and the spindles are finished. It is obvious that, in making a hundred or more spindles at a time, "A Mechanic's" scheme "to multiply tapers" cannot be tolerated. It is better to keep the reamer to a standard than to make test arbors and plugs to accommodate its changes. It is of the highest importance that milling machine spindles have holes that are alike. Having made a hundred of them alike, it is absurd "to multiply tapers" in the next hundred spindles, merely because they are for lathes.



Tapers

The American Patent System.

In my article in your issue of March 6th, on the effect of foreign patents, in limiting the duration of United States patents for the same invention, granted after the foreign patent, I stated guardedly, as my own opinion merely, that an American patent could not be limited by failure to perform any special acts, such as payment of stamp taxes, which the foreign law might make indispensable to the life of the prior foreign patent.

The question was this: Suppose an inventor has patented his invention abroad, and afterwards patents it in the United States. The ownership of the foreign patent passes to others, usually themselves foreigners, who reside in the foreign country, and whose acts are necessarily very largely out of control of an American inventor. Will the acts of those foreign owners, in neglecting to perform some duty required by the foreign law, and thus killing the foreign patent, also, at the same time destroy the American patent? for our law says the American patent shall terminate at the same time as the foreign patent having the shortest term to run.

My answer to the question was that the American patent would not expire by reason of the forfeiture of the foreign patent, but would live to the end of the full term to which the foreign patent would have lived, if all the acts required by the foreign law had been performed.

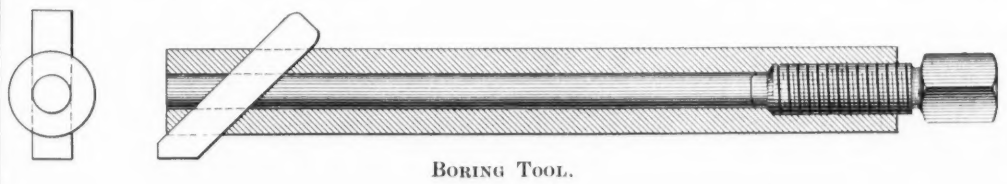
This answer was guardedly given, as being opposed to the views of the Circuit Courts, and to the general opinion of lawyers. But it has been completely ratified in a decision of the Supreme Court, rendered March 24th, in the case known as Pohl *vs.* the Anchor Brewing Company. The court has there decided that the duration of the United States patent cannot be limited by anything but the term expressed in the foreign law, and cannot be affected by any forfeiture of the foreign patent, by acts occurring after the foreign patent is granted.

The decision will prove of great value to American inventors; for, when taken in connection with another recent case, it has settled (1) That whether an inventor pay the whole of the very large fees required for the full foreign term, at once, or at first pay only the small fee for the first few years of the foreign patent, afterward, from time to time, paying the remaining fees in installments, in every case the American patent is valid for the whole of the foreign term. (2) That, if there is a foreign patent in force when the American patent is granted, the latter cannot be injured by any failure to observe any local duties imposed by the foreign law.

The American patent is out of reach of foreign forfeiture. D. WALTER BROWN.

A Boring Tool.

Mr. A. Gray contributes to our contemporary, the *English Mechanic and World of Science*, a sketch and description of a boring bar for use in the tool post of a lathe, which might prove handy in many cases. It consists of a piece of weldless steel tubing of about the proportions shown in the cut, though it may be of any desired proportions, according to the work it is to be used for. Near one end a square hole is put through it at an angle, as shown, for the reception of the cutter, which is held in place by means of a piece of steel wire, which passes through the tubing loosely, is beveled off at the end to suit the angle of the cutter, and is forced against it by means of the set-screw shown at the back. The tubing is then held in the tool post by means of **V** blocks, such as shown in our issue of March 27, by A. W. Parkhurst. Our engraver has so shaded the cut as to make it appear as though the end of the tube beyond the cutter was plugged up; but this is not the case, as it is obvious the cutter will be more firmly secured by leaving this open, and letting the cutter have a bearing on the tube only.


BORING TOOL.

A well-known mechanic of our acquaintance happened to hear a conversation the other day, between a couple of young ladies, on the subject of putting up picture moulding.

One of them, mentioning a miter-box, was asked what a miter-box was, and replied that it looked like an old-fashioned kind of sink drain, with slots cut bias for the saw to go in.

The Master Mechanics Association will hold its convention this year at Old Point Comfort, Va., beginning June 17.

Fink Swindles a Thread Mill.

The Clark Thread Company, of Newark, N. J., write us:

We recently purchased the right to use Fink's patent lubricating oil mixture, on the strength of the splendid recommendations it had. We have since tried it, and are unable to make it work, and therefore take the liberty of asking you what you know of its merits.

In reply we sent the Thread Company a few back numbers of the AMERICAN MACHINIST, containing the experience of large establishments in other lines of business, who were similarly unable to "make it work." We think the Thread Company's own experience will not surprise them, after reading up on Fink's record.

Now that highway improvement is getting so much attention in many parts of the country there is a special timely interest in the contribution to the literature of road-making by *The Engineering and Building Record*, of New York. That journal offered some time ago cash prizes for essays on Road Construction and Maintenance, and as a result received twenty-one elaborate papers on the subject. The prizes have just been awarded by a committee to S. C. Thompson, New York; I. T. Pope, Austin, Texas, and John P. Pritchard, Quincy, Mass. The three essays given prizes are being published in full, several others which received honorable mention are to be given in abstracted form, and finally it is announced that the awarding committee will give a criticism upon the whole. The members of this committee, Francis Collingwood, Edward P. North and James Owen, are civil engineers of high standing, with special knowledge of road-making, and their work in the matter cannot fail to prove of the highest value.

Experiments which have been made recently on the Austrian state railroads, with wheel tires of Krupp's crucible cast-steel and Martin steel, have yielded interesting results. For the purpose of the trials, three wheels on one side of a locomotive were furnished with tires of one kind of steel, and those on the other side with tires of the second kind. The profiles, to start with, were, of course, exactly alike. After two years' running, measurements of the profiles showed that the Krupp steel tires had worn down on an average 10 millimeters (about 0.4 in.), while the Martin steel tires had worn down 14 millimeters (about 0.56 in.) Including the weight of the metal removed in again turning down the tires to the normal profile, the weight lost, due to wear, was 40.4 kilograms (88.88 lbs.) in the case of Krupp tires, and 56.4 kilograms (124.08 lbs.) in the case of those of Martin steel.—*National Car and Locomotive Builder.*

As a matter of justice to the students of Stevens Institute, we state that a thorough personal examination convinces us that our report of a performance by them, in issue of March 27, was incorrect in some particulars. There was some hilarity, but no windows were broken, nor were there any ladies aboard of the boat, to be either frightened or entertained by their antics.

Literary Notes.

PRACTICAL ELECTRICS. A Universal Handy-Book on Every-day Electrical Matters.

This is a book intended especially for scientific amateurs who are interested in electrical matters, and treats of matters of a useful and practical nature, pertaining to the science, not found in most of the more pretentious works. So little that is of use, or that can be depended upon, is published upon this subject, that, to those having electrical apparatus of any kind in their houses, it ought to prove useful as a reference book. It is a reproduction of the chapter on Electrics, in the Third Series of "Work-shop Recipes." The publishers are E. & F. N. Spon, New York.

Stress in Structures.

PARALLELOGRAM OF FORCES.

In our issue of February 20, current volume, we have shown how, with the aid of the parallelogram of forces, we can find the stress in the different members of a toggle joint. The numerous questions which we have received, asking for the methods of finding the stress in other structures, have led us to believe that a more extended application of the principle of the parallelogram of forces, and experimental investigations of this principle, will be of interest to many of our readers.

Let $B\ C$, in Fig. 1, represent a tie rod, and $A\ C$ a strut, both attached to the post D. These support, from the point C, a weight G of 5,000 pounds. It is required to find the tension or pull on the tie rod $C\ B$, and the compression or push on the strut $C\ A$.

Draw the center line $C\ B$ of the tie, and prolong it towards f; also draw the center line $C\ A$ of the strut; and through the point C, in which these center lines intersect, draw the vertical line $C\ G$. A portion $C\ i$ of the line $C\ G$ must now be laid off so as to represent the weight or load G. To accomplish this we must adopt some unit of length to represent a pound, or a certain number of pounds; let us choose 1 inch to represent 500 pounds.

Since the line $C\ i$ must represent 5,000 pounds, it follows that $C\ i$ must be

$$\frac{5{,}000}{500} = 10 \text{ inches long.}$$

Through the point i draw $f\ i$ parallel to $C\ g$; also through the same point draw $i\ g$ parallel to $C\ f$, and thus complete the parallelogram $C\ f\ i\ g$.

The side $C\ f$ represents the tension on the tie rod; if we find it to be $7\frac{1}{2}$ inches long, then the tension will be $7.5 \times 500 = 3{,}750$ pounds. Here we have multiplied the length by 500, because every inch represents 500 pounds.

The line $C\ g$ represents the compression on the strut, and since, in this particular case, the line $C\ g$ is equal to $C\ f$, the compression on the strut will also be 3,750 pounds.

The tension and compression here found are due to the weight or load G alone. In large structures the weight of the tie and strut must be taken into account.

The force acting horizontally to pull the bolt B out of the post is equal to the force which $f\ d$ represents, and the horizontal pressure of the strut against the post D is equal to the force which $d\ g$ represents; all measured with the scale of units previously adopted. The vertical downward pressure on the bolt B is equal to the force $C\ d$, and the vertical downward pressure on the strut is equal to the same force. The shearing stress on the pin B is equal to $C\ f$, and the shearing stress on the pin C is equal to $C\ i$; all measured with the same scale. Of course all these stresses will be somewhat changed by taking the weights of the different members of the structure into account, but for comparatively small structures these weights may be neglected.

To show how the stresses we have found can be used for determining the dimensions of the different members, we will take one example only.

We have found that the tension on the tie rod is 3,750 pounds; the rod is made of round wrought-iron; the stress per square inch is not to exceed 10,000 pounds. It is required to find the diameter of the rod.

Here we only need to divide the tension by the stress allowed per square inch; the quotient will be the number of square inches in the cross-section of the rod. Thus:

$$\frac{3{,}750}{10{,}000} = .375 \text{ of a square inch,}$$

and the corresponding diameter will be a little over $\frac{11}{16}$ of an inch, which is the diameter of the rod.

In order to show that this graphical solution of our problem is correct, let us consider the manner by which the principle of the parallelogram of forces can be experimentally established.

For this purpose we may use an apparatus similar to that shown in Fig. 2. It simply consists of a bar Z supported by a column. To this bar two pulleys, X and Y, about two inches in diameter, are attached. These pulleys must turn freely on their axles. The distance between the pulleys is not of much importance; about 2 or 3 feet will answer the purpose. Over these pulleys we pass a thread long enough to enable us to suspend the weights as shown in the figure. For the purpose of experiment we may choose any weights. Let each of the weights D and F suspended from the ends of the thread be 3 pounds, and the weight suspended from the center of the thread 4 pounds. After a few oscillations this system of weights will come to rest, and the threads place themselves in a

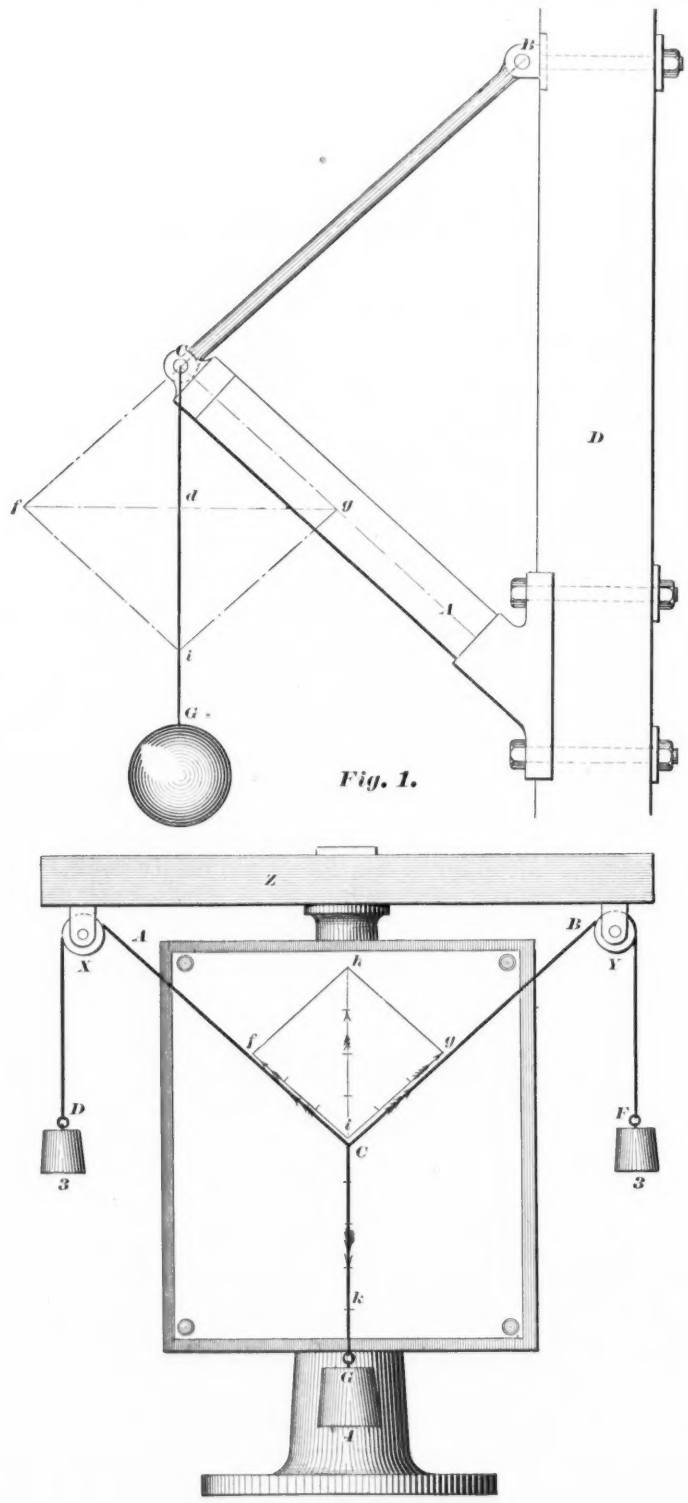


Fig. 1.

Fig. 2.

STRESS IN STRUCTURES.

certain definite manner. If we move the point C to any other position, it will not remain there after it is liberated but will return to its original position.

In this arrangement we have a point C acted on by three forces. These three forces are represented by the tension of threads due to the weights suspended. The directions in which these forces act are represented by the directions of the threads $A\ C$, $C\ B$ and $C\ G$; the arrows show that all the forces pull on the point C. But these forces are not completely shown, because the threads do not give the magnitudes of the forces; they only show the directions in which the forces act. In order to represent the magnitudes as well as the directions, we proceed as follows:

Fasten a piece of paper to a drawing-board, and fix the board behind the threads. Draw the line $f\ i$ parallel to $A\ C$, the line $i\ g$ parallel to $C\ B$, and another line $C\ k$ parallel to $C\ G$. We now adopt some unit of length to represent 1 pound; say 1 inch.

Since the tension on the thread $A\ C$ is equal to 3 pounds, we make the line $f\ i$ 3 inches long; and for similar reasons we make $i\ g$ also equal to 3 inches. The tension on the thread $C\ G$ is 4 pounds, and therefore we must make $C\ k$ 4 inches long. Now attaching the arrows as shown, we have fully represented the three forces $f\ i$, $i\ g$, $C\ k$ acting on the point C. The magnitudes of these forces are represented by the length of the lines, and the directions in which they act are represented by the directions of the lines and arrows. Since the point C is at rest, we know that the three forces are in equilibrium. We also conclude that the combined effect of the two forces $f\ i$ and $i\ g$ balance the force $C\ k$.

Through the point f draw a line $f\ h$ parallel to $i\ g$; through the point g draw $g\ h$ parallel to $f\ i$, cutting $f\ h$ in the point h, and thus complete the parallelogram $f\ g\ h\ i$. Lastly draw the diagonal $h\ i$.

The force $f\ i$ tends to pull towards the left in an upward direction, as shown by the arrow; the force $i\ g$ tends to pull towards the right in an upward direction. Since these forces are equal, one cannot preponderate over the other, and the result is that the two forces acting together tend to pull directly upwards along the diagonal $i\ h$; for this reason the arrow on $i\ h$ must point upwards. Examining this diagonal we find three special facts in connection with it:

First. It is in the same straight line with the direction of the force $C\ k$.

Second. The length of the diagonal is equal to the line $C\ k$.

Third. The diagonal bisects the angle $f\ i\ g$.

The first and second facts show us that a force represented by the diagonal $h\ i$ will alone balance the force $C\ k$, because both forces act in the same straight line, but in opposite directions; and these forces are equal to each other because their magnitudes are represented by the length of the lines $h\ i$ and $C\ k$, and these lines are equal. But we have already seen that the combined effect of the two forces $f\ i$ and $i\ g$ just balance the force $C\ k$, and, since $h\ i$ will do the same thing, it follows that the forces $f\ i$ and $i\ g$ can be replaced by the force $h\ i$. A force which can replace two other forces is called the resultant of the two forces.

Here, then, we have shown experimentally the important property of the parallelogram of forces stated in our issue of February 20th, namely: If two forces acting on a point be represented in magnitude and direction by the adjacent sides of a parallelogram, then the resultant of the two forces will be represented in magnitude and direction by the diagonal of the parallelogram which passes through the point on which the forces act.

We must carefully distinguish between the force represented by the diagonal and the force $C\ k$ due to the weight G. The latter force is the one which holds the two forces $f\ i$ and $i\ g$ in equilibrium, whereas the diagonal $h\ i$ represents the resultant of the same two forces, it shows the combined effect of these two forces, consequently the arrow on the diagonal must in this case point upwards, and the arrow on $C\ k$ must point downwards, as we have previously explained.

We now come to the third fact, namely, the diagonal $h\ i$ bisects the angle $f\ i\ g$. The reason for this is that the weights D and F are equal. Had these weights not been equal, the diagonal would not have bisected the angle $f\ i\ g$. This will be considered in another paper.

From the foregoing it will be readily perceived that if we know the resultant of two forces, and also the direction in which these forces act, we can easily find their magnitudes. Thus, for instance: Let $h\ i$, in Fig. 2, represent the resultant of two forces; the directions in which these two forces act are represented by the lines $f\ i$ and $i\ g$. It is required to find the magnitudes of the two forces. Through the extremity h of the diagonal $h\ i$ draw $h\ f$ parallel to $i\ g$; again, through h draw $h\ g$ parallel to $f\ i$. The required magnitudes may now be obtained by measuring the lines $f\ i$ and $i\ g$ with the same scale as was used for laying off the number of pounds on the line $h\ i$.

Comparing this method of finding the magnitudes of two forces, when their resultant is known, with construction in Fig. 1, we find that the two methods are identical.

Reduction of Indicator Diagrams.

By W. H. Booth.

Since last writing on power estimation, further opportunity has been afforded me, of finding some rule for estimating the power of each diagram, on the assumption that it should be taken under same condition, but at a higher or lower speed. I had a number of figures, some 100 or more in number, and by careful comparison of figures taken at identical conditions as to head of outlet of pump and length of delivery pipe, I arrived at the conclusion that, calling r the speed at which the diagram was taken, and R the speed to which all diagrams should be reduced, the formula for reduction of horse-power to datum speed would be $I.\ H.\ P. = \frac{R^{1.45}}{r^{1.45}}$. To work this out, requires of course a table of logarithms, but the process is simple. For example, I find a diagram to figure out to 78.55 I. H. P., as

taken at 76 revolutions. Most of my figures are taken at 76 and 84 revolutions, and I want to reduce all to a mean of 80 revolutions. In a table of logarithms, I find the logarithm of 76 to be 1.88081, and the logarithm 80 to be 1.90309. Raise each to its 1.45th power, by multiplying each logarithm by that index, and get logarithm $76^{1.45} = 2.72717$, and logarithm $80^{1.45} = 2.75948$.

Then to divide the one by the other, subtract the logarithms, and there is obtained the ratio .032306, which is the logarithm of 1.077 nearly.

The logarithm of 78.55 is 1.89575; adding this to the above ratio logarithm gives 1.927486, and this is the logarithm of 84.62, which is the horse-power, as would be shown by the engine working under the given conditions at the higher speed, however, of 80 revolutions.

Working out 22 separate sets of figures with varying speeds of centrifugal pump, and various elevations of discharge through two different lengths of pipe, the method seems to come out well. Many sets of diagrams were taken for the speeds of both 76 and 84, all other conditions being equal, and whilst the actual figure at 76 rev's. always gave much smaller horse-power than the 84 figure, yet when reduced to 80 all round, the previously smaller powered card would come out with the larger power. Some such results were to be expected under the different conditions as to ascertaining exact speed, but taken all round, and averaging the power difference between each card, and the next following, it appears that a centrifugal pump of 40 inches diameter, elevating water to varying heights, required an additional power of 10.871 indicated horse-power for each 40 inches additional elevation of discharge when the length of discharge pipe was 525 feet.

When the length of pipe was 251 feet only the difference of horse-power due to each 40 inches comes out as 11.5. At first it seemed as though this should not be right, but on second thought it did seem right, for the resistance of the shorter pipe would be less, and so the pump would pass more water at each elevation of discharge than when the pipe was long, and therefore the power required would be greater, as it proved to be, and so I conclude that the output of the pump through the short pipe is $5\frac{8}{10}$ per cent. greater than through the long pipe, and in every case I found the pump to show a bigger power through the shorter pipe, as though the greater freedom of the water to flow away enabled so much more to pass the pump, that there was less slip than against the maximum resistance, and more work done in water raised. This, too, coincides with one's knowledge of centrifugal pumps, that at a certain speed they will do work, and at a few revolutions less they will do nothing, for the centrifugal energy of the water is less than the resistance head. At such a critical speed and head, the pump will tend to race, and if it does not race, water will flow back through the pump.

Necessarily the index figure 1.45 will not be of universal application to every description of work.

Some machinery will vary differently from others, for a variation in the speed of engine or other prime mover, but in all probability the use of say an index of 1.5, will in all cases give fair results.

Written in the form of a rule:

To find what horse-power an engine would indicate at one speed when the power is known at another speed: Multiply the power by the 1.5th power of the desired speed, and divide the product by the 1.5th power of the speed at which the power was taken. The result is the probable power at the new speed.

In any case the result will be nearer the truth than so coarse an approximation as changing the power in the simple ratio of the speed; for, as explained already, the reason an engine runs at a certain speed is that it can run no faster with that mean pressure then upon it, and so it stands to reason that for an assumed higher speed there must be a higher mean pressure, and it is really to find such higher mean pressure that is wanted. The rule given finds the horse-power which is a product of the speed and pressure, and the increased mean pressure is easily found from the power.

Thus in the example given, the mean pressure necessary to give 80 revolutions is as $\frac{84.62}{80}$ is to $\frac{78.55}{76}$ or 1.0237, or in other words an increased mean pressure of about $2\frac{1}{4}$ per cent. has added $\frac{80}{76 \times 100}$ = nearly $5\frac{1}{8}$ per cent. to the speed of the engine, and increased its power nearly $7\frac{3}{4}$ per cent., for the increased mean pressure acts oftener, and the increased power is the product of both the speed and pressure, and so cannot be calculated by simple increase of one factor only.

For any class of machinery, the true index for conversion can only be obtained by trial. In making determinations, it is perhaps best to take indicator diagrams at a few revolutions each side of the datum, as at 76 and 84, on each side of 80, and find the index by trial and error sufficiently near for practical purposes, by taking a mean of all the powers at 76, and a mean of those at 84, and using that index which raises the power at 76 to the same figure as it reduces the power of those at 84. The index thus found may then be used for all the other speeds.

This is the method followed by myself in working out the present tests.

A Safety Lantern.

We give with this an illustration of a new safety lantern designed especially for the use of watchmen employed in mills, factories or warehouses where inflammable materials are used or stored, or wherever it is desirable to take special precautions against fire. It is made in the best manner of brass, the lamp fitting into its place in such a manner that it is impossible for it to become accidentally detached. The lantern is intended for burning pure sperm oil, and is fitted with a small brass padlock, which can be locked when the lantern is handed to the watchman for the night, and the key retained at the office or headquarters of the building, thus entirely preventing tampering with the lantern during the night.

Mr. Edward Atkinson, President Boston Manufacturers' Mutual Fire Insurance Company, in a report in which he commended this lantern, has the following to say regarding the use of sperm oil for this purpose.

"Sperm oil of the best quality is the only suitable oil fit to be burned in a watchman's lantern, although lard oil is commonly used. It is admitted that the price of sperm oil is customarily one-third more than the price of pure lard oil; but, in order to test alike the economy, safety, and suitability of oils, we have lately burned several kinds for several days, keeping a record of the results.

"Three kinds were selected: first, pure sperm oil; second, pure lard oil; third, lard oil which had been chemically treated for the removal of albuminous substances. Each of the lard oils burned sufficiently well until the oil in the lamp was about half consumed. Each then began to burn dimly and finally failed, leaving a residuum of about one-third part of the oil unfit to burn. Of course, when the lamps were filled with fresh oil on the top of the residuum, they burned less well and would finally become useless. Sperm oil burns clearly and well, until it is all consumed, there being at the end a very few drops left, insufficient to be taken up by the wick. Sperm oil is, therefore, the only suitable oil to be used; and, in view of its complete consumption, it does not cost any more than lard oil."

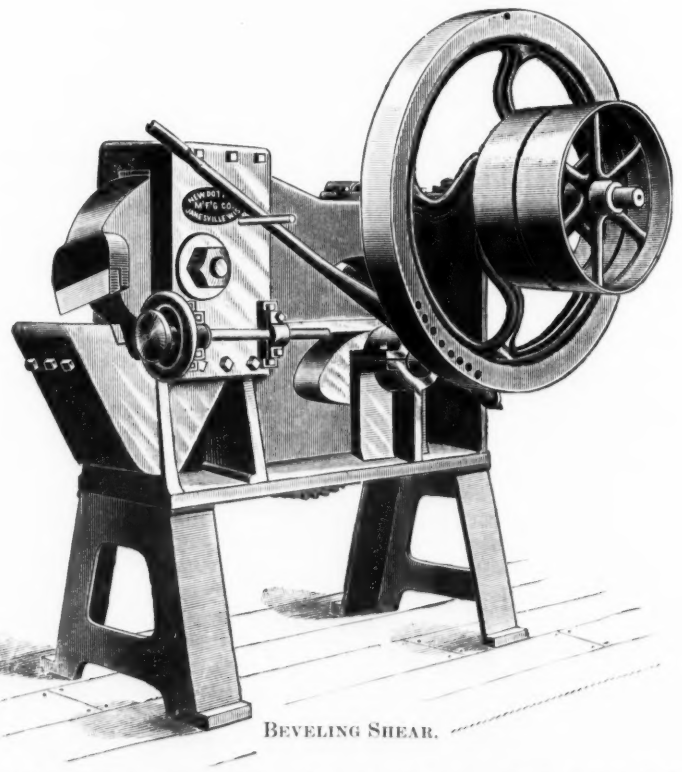
Safety Lantern.

The lantern is manufactured by J. H Burrell, Jr., 4948 Germantown Ave., Philadelphia, Pa.

Beveling Shear.

The accompanying illustration is of a shear designed especially for beveling boiler, ship, or other plates, built by the New Doty Mfg. Co., Janesville, Wis.

The machine consists essentially of the main frame in which is pivoted a lever operated by a cam which is on a shaft driven by means of the pulleys shown, through the medium of powerful gears. The motion of the machine is controlled by a clutch, and the lever seen at the side.



Beveling Shear.

Unlike the plate planer, this machine will, of course, bevel plates of almost any form, such as throat sheets, flanges of drums, plates bent to a circle or ship plates of any curve.

Whatever tendency there may be to displacement of the work when being cut, is overcome by the stop shown at the side of the machine. The machines are made in two sizes, the smaller one capable of beveling sheets up to $\frac{1}{2}$" thick, the larger one up to 1" thick.

LETTERS FROM PRACTICAL MEN.

Belting.

Editor American Machinist:

Please give me room in your columns to say that "50 years', save one," experience in handling belting, enables me to fully endorse the letter of Mr. F. P. Wolcott, in your issue of March 27th, in every particular. I sometimes use soap or resin in mak dynamometer tests, where I have to use a *temporary* narrow belt for 10 or 15 minutes, and want to keep speed up sharp; but I would never use it on a permanent belt.

The driving device spoken of is old here in New England. I cannot undertake to remember how many years I have known it. In fact, you cannot find any way of belt transmission that some ingenious Yankee has not already tried. If your correspondent J. E. J. will cut a piece of belt with a sharp knife, and examine it carefully, he will soon see the reason for the hair side wearing longest next the pulley.

The thin outer skin, in which the hair is set, becomes hard and brittle in tanning, and will crack with the continued expansion and contraction if outside, but, if inside, next the pulley, its motion is more uniform, and its very hardness enables it to stand the wear.

With a perfectly new belt, the flesh side next the pulley will cling better, and pull a heavier load, as my own experiments show, and herein Rankin is right; but, when it comes to durability, the hair side soon gets softened and fitted to the pulley surface, and will as Mr. Wolcott says, wear 25 per cent. longer every time. Theoretically, the center of motion is in the center of the belt, and double belts should be made by gluing the two hair sides instead of the two flesh sides together, but, as they should only be used on very large pulleys, where the expansion and contraction are slight, it is probably better to use the common plan, and expose the hair sides to the wear.

Samuel Webber.

The Decimal System—Emery Wheels.

Editor American Machinist:

From time to time I have seen letters on both sides of the "decimal" question, and being interested, have watched them quite closely. The latest scheme in that line comes from a Mr. Cooper. He has a unique, though, as it seems to me, unnecessary—plan of adaptation. After saying that the standard inch should be preserved, he goes on to "propose taking for a unit of the scale a space equal to one and one-half of the standard inch, and dividing this into ten equal parts, subdividing, etc." His argument is that one one-hundredth of the present inch is too small for the eye to see readily, and so he wants to increase them one-half. He would make ten inches one foot, and in that is in accordance with my ideas exactly—but why change the inch—or if we do, why not take one-tenth of the standard foot as a standard unit? We have a standard inch, and I have read it is identical with the measurement of the ancient Egyptians, so it seems the best place to start for the new system, with the inch as the unit. Don't think I cling to it on account of age—for that reason has little weight, but it is used extensively as a unit in many parts of the world.

Ten inches one foot—now here comes the rub—do we want any measurement between feet and miles? Yards are rarely used in calculations, and seem unnecessary, and feet would do very well, but how many feet to a mile—surely not ten or a hundred, nor even a thousand. Ten thousand would be a trifle over a third more than the present mile—shorter then than some foreign miles. It does seem quite a jump from a foot to ten thousand, and if necessary a half way measurement could be devised very readily.

But the decimal system is the right one without doubt, and should be adapted to everything, as it is to our currencey. The idea of rods, perches, links, chains, long ton and short ton, belong to the past.

Decimals facilitate calculations in every way, and are greatly to be desired by all who

have estimates to make, or mathematical problems of any kind to solve.

The present inch is readily divided to hundredths on a scale, and by micrometer to ten-thousandths, and though the expression one one hundredth of an inch has a formidable sound, it is just as easy to work to hundredths as to 64ths, much depending on the touch.

Mr. Cooper deserves credit for starting a new scheme, which, even if unnecessary in part, has the good quality of originality, and of drawing forth communications from others on the subject. Let us hear from all interested on the subject, and don't stop at linear measurements; extend it everywhere, weight, liquid measure and thermometer. The centigrade is just the thing, not the arbitrary odd numbers of 212 and 32 for boiling and freezing respectively.

The emery wheel is being discussed at length in your paper, and many points brought out. Much of the dissatisfaction is based on prejudice, and much on discouraging experience with a wheel improperly handled. I have seen turret men grind these hollow milling tools till the points would *blue*, then cool them off, and either blame the tool maker or else the castings for being so hard on tools. The cure for this evil is to have the tools all ground by one man, though in a small shop this is not always feasible.

Some wonder why the emery wheel heats more than the grindstone, never taking into account the comparative surface speed of the two. We probably do not obtain the best results from them, but hope to learn sometime; meanwhile do we run our grindstones to the best advantage? I have a lingering fondness for the old grindstone, when I want a nice job, even though I must walk 40 feet to that, and about 6 to the emery wheels—it is probably either prejudice or else the wheels are not suitable—they are 8-inch wheels—one 46 and the other 70, I think, and run at about 1,200. Can any one give experience with same? For much of my tool work, they are fine, for taps, reamers, boring bars, etc., the grindstone is forgotten—but when I want a nice thread tool, that's where I go.

Seems as though each had a place in every shop, that the other doesn't quite fill.

Some where I saw an article saying, that if the maker of emery wheels said run it at 1,200—run it 1.800—but that doesn't seem first class advice. When the doctor says take 12 pills, we don't take 18, unless we are anxious for a coroner's inquest; and no one can blame any maker's goods unless they are used as directed. 'Tis a field yet to be developed, *i. e.*, fully, and, as we learn more, the less trouble we will have with emery wheels burning tools, bursting, etc.

FRED H. COLVIN.

Grindstones and Emery Wheels.

Editor American Machinist:

In the new planer room of F. E. Reed, at Worcester, Mass., I think they have the right idea of tool grinders. They have a large emery grinder, and right by the side of it a grindstone, about the same size. There is a man whose business it is to keep them true, and he does it. If a man wishes to take off lots of stock from a tool, he can do it on the emery wheel, and give it a finishing touch on the grindstone, and after touching it up with an oil-stone it is in good working shape.

I think the majority of men do not realize that they do not need to bear on a tool as hard when using emery wheels as they do on grindstones, to remove the same amount of stock.

I, for one, say do not condemn either emery or grindstones, for there is a place for both, the same as was pretty well decided in regard to milling *vs.* planing, in these columns a little while ago. F. F. D.

Building and Loan Associations.

Editor American Machinist:

Permit me to take exceptions to your leading editorial in issue of Feb. 20, entitled "National" Building and Loan Associations. While neither directly or indirectly interested in the association in question, my love of fair play prompts a reply to your editorial.

You have given the figures handed in by the Bank Examiner, but said figures seem to have been distorted purposely by that official. His decision was not upheld by the Attorney General, and the "American" has been vindicated.

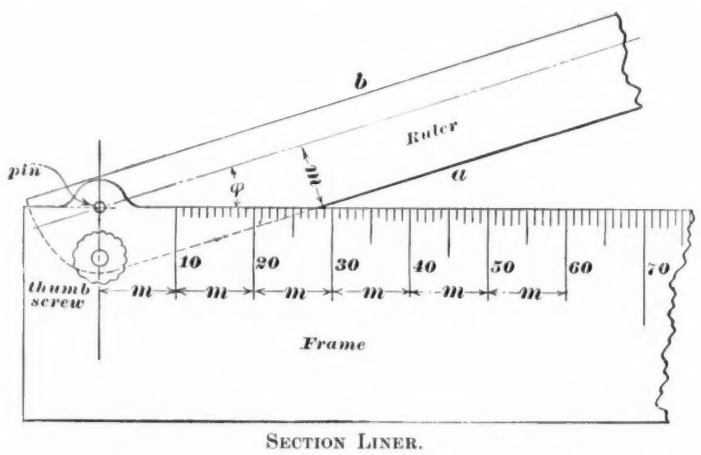
The attack upon this association appears to have been the work of banking institutions, whose business is badly hurt by the inroads of building associations. Enclosed you will find a sworn statement of the "American's" affairs for February, also a clipping which contains a survey of the situation between the banks, and the building and loan associations. JAMES F. HOBART.

[We have no quarrel with the American Building and Loan Association, of Minneapolis. In our issue to which Mr. Hobart refers, we quoted from the report of the Public Examiner, of the State of Minnesota, because that report bore the impress of official action. We trust that the report of the company is in every way true, and certainly have no reason or inclination to throw doubts around it. Further than this, we see no occasion to modify what we said in relation to the matter in our issue of Feb. 20.]

Amateur Engineering.

Editor American Machinist:

I know of nothing that gives me more pleasure than to read such an article as appeared in the last number of your paper, under the head of "Amateur Engineering." Several such instances have come under my own observation. A certain concern wanted a new boiler. The Superintendent asked the engineer for plans and specifications for same; these were submitted to the Board of Directors, and declared by one of the learned gentlemen to be insufficient. Taking them home, he had a friend prepare others, for which $25 was paid. Bids were advertised for, and the contract for building boiler was awarded to a man who had no particular business. After passing through the hands of two other middlemen, a certain boiler maker undertook the job, and in due time it was delivered. Then the fun began. The engineer kicked. The insurance company's inspector made an internal inspection, and condemned it. In riveting up sheets, holes had not "come fair," and wherever this had occurred, small rivets had been resorted to. In several places, and notably where dome was joined to shell, the metal was cracked between the rivets, extending in some places from 6 to 8 inches. The bracing was inadequate, and taken altogether, it was a bad job. To be brief, the engineer was then instructed to go to a reputable boiler maker and order such a one as in his judgment would best suit the needs of the concern. Notwithstanding such an experience, this same smart director, when a new steam pump was talked of, claimed to be well posted in that line, was appointed a committee of one with full power to purchase, etc. The engineer gave him the dimensions of the pump, viz., 16" steam cylinders, 10½" water cylinders, 12" stroke, duplex. On his journey home the director suddenly became possessed with an idea, and it being such an unusual thing, he immediately made use of it, and cut down the size of the steam cylinders from 16" to 8". Result, when pump was set up, and steam turned on, the water end had the advantage, and the pistons would not make a stroke. The director did not want to give in, and acknowledge his blunder, and the matter rested for more than a year, when the steam cylinders were removed and larger ones substituted at an additional expense of $475. The world is full of just such smart Alecks. BAX.



SECTION LINER.

Inspection and License Law.

Editor American Machinist:

The article in your issue of March 20, advocating the enactment of laws in each State, requiring all those in charge of stationary steam boilers or engines to be licensed, broaches a subject of vast importance, and one that should not be discussed without being thoroughly ventilated.

The numerous fatal and sad accidents that occur each year from the explosions of stationary boilers would seem to warrant the making of stringent laws relative to management and care of steam boilers. A law qualifying an engineer only would be certainly very defective, and would not accomplish the end at which it would be aimed, inasmuch as the foremen or superintendents are oftentimes responsible for the neglect of boilers by dispatching those in charge to some remote part to do a "small" job. Should an engineer decline to obey a foreman's or superintendent's order of this sort, he generally receives his "walking papers," as experience and observation have impressively taught the writer.

A law requiring all foremen or individual owners, having the oversight of steam boilers, to be competent in this line themselves and compelling them to employ only qualified men for such position, might be of more benefit than a law merely to qualify an engineer.

The foreman, or individual owner, who knows the hazardous or destructive propensities of a neglected steam boiler while in active use, will not trust its care to an incompetent man, and will avoid all means of diverting his attention from its care.

This is the method adopted by railway companies, and explosion of locomotive boilers is a rare occurrence.

Also a law requiring the semi-annual inspection of all stationary steam boilers by an expert State Inspector would not be an unwise provision.

Incompetency is generally rewarded with small compensation, and the employer looks upon this as a fruitful source of profit, which it never proves to be. The machinery speaks for itself in such cases.

This subject should be agitated by all the mechanical periodicals and the newspapers in the States, that it might receive the attention of the law makers. J. F. B.

Section Liner.

Editor American Machinist:

In order to make the youth the "adjustable isometrical parallel ruler," described in your last issue, in simplicity even more fully to outshine its name, I wish to suggest to do away with the adjusting quadrant as described, simply by dividing up the frame itself instead of the ruler. Thus:

In making edges *a* and *b* of ruler parallel to each other, and setting the ruler so that the point, where edge *a* and edge of frame intersect each other, fall together, with a certain number of the scale, for instance, 30, you will, of course, have that the distance between lines drawn along edge *b* is = pitch of rack × sin Φ. Now, the expression for sin Φ, the divisions on frame being made equal to distance *m* between center of pin and edge *a*, is

$$\sin \Phi = \frac{m}{3m},$$

∴ distance between lines = ⅓ of pitch of rack.

If pitch of rack is made $\frac{1}{10}$ of an inch, this division 30 indicates, therefore, 30 equal spaces per inch.

The thumb-screw has been moved ⅜ of an inch away from turning pin, to insure rigidity. ARVID LEVIN.

Elevating Tool Rests.

Editor American Machinist:

As a result of some considerable experience with elevating tool rests of various degrees of excellence and depravity, I am led to the conclusion that the most common fault among those which rise vertically, and are intended for use on gibbed lathes, is that too much vertical movement is provided for, thus enabling the length of the bearing between the two parts to be reduced so much as to destroy all rigidity.

I can see no necessity for an adjustment by the screw of more than ¼", and if no more than this was allowed there would be, I think, much more satisfactory results secured from them. Of course, tools vary much more than this amount in height, but it seems to me totally unnecessary to allow for all of this in the adjustment of the rest, but, by having a number of good steel collars to put over the tool post for the tool to rest on, varying in thickness by ⅛" any tool could, when placed in the post, be brought within the range of adjustment by a collar of suitable thickness, and by having a gap cut out of these collars at one side, so that they could be shoved under the tool without removing it or the wrench from the tool post, the adjustment could be made more quickly than by winding a screw for the whole distance. When thus set within the range of adjustment, ¼" of movement would be ample, and practically the full length of bearing which the proportions of the lathe admitted would be at all times maintained, and the maximum rigidity secured.

Both the rests recently shown by you have far more adjustment than is needed, it seems to me, and it is plain that when raised to or near their highest point, they will be anything but rigid. And we all know that they will sometimes be raised and used at the highest point, if the facilities for getting them there are provided; then, when lack of stiffness is manifested, the rest is apt to be condemned.

The main advantage of the elevating tool rest is that it enables the tool to be adjusted to the proper height after it is secured in position and properly set.

When a thread tool for instance, or any other tool, which it is necessary to be particular about the shape and setting of, is set, and is then found to be slightly too high or too low to cut well, it is very aggravating to be unable to change its height without having the setting operation to go through with again, and because this difficulty is avoided by them is the main reason why lathesmen like the elevating rest. But one-quarter inch adjustment by the screw is plenty for this, and the balance of the adjustment can be made by the collars spoken of, before the tool is set, much more quickly than by the screw, and the rest will not be weakened by being nearly screwed "off its base," to bring the tool high enough.

FAY.

The Jonson Foundry & Machine Co., 118th street and Harlem River, have now under construction the W. S. Light-house Tender Azalea; length, 154 feet; breadth, 25 feet; depth, 12 feet 3 inches.

The inspectors of the Forth Bridge, in their final report, speak of the construction as "a wonderful example of thoroughly good workmanship."

Force in the Steam Engine and its Relation to Smooth Running

BY PROFESSOR JOSEPH TORREY.

EIGHTEENTH PAPER.

In discussing the question of how counterweights should be proportioned in different cases, all we can hope to do is to get a clear and intelligent insight into, first, the forces which counterweights generate, and second, the strains these forces set up in the engine frame. With a clear understanding of these points, and knowing the elements of any particular engine, it is not a difficult matter to design a counterweight that will at least develop a *known amount* of force in any direction or along any of the principal lines of strain.

As was said in a previous paper, while circumstances and dimensions will vary within wide limits, there is no good reason why engines of substantially the same weight, proportions, and under sensibly similar circumstances, should not be counterweighted alike.

We have seen that if the counterweight be increased till its centrifugal force is equal to the average of the inertia forces on centers, the tendency to vibrate horizontally will be removed almost perfectly. It is very often the case that following an action to its extreme brings out its features best, and accordingly we will consider this case of "balancing to the full extent" first, and try and get a clear idea of the nature and distribution of the resulting forces.

First.—At the ends of the stroke the strains are almost all horizontal, and balanced as has been shown. Whatever excess there is, is simply due to the effect of the angularity of the connecting rod on the inertia of the reciprocating parts. The trouble begins when the engine moves off the center; from that time on, the counterweight substantially has things all its own way. It is true that its powerful centrifugal force is resisted and neutralized somewhat by the centrifugal force of the large end of connecting rod, together with crank and pin, but this contrary action will be rather slight in most cases, as engines are built. Thus it happens that, when the engine is moving away from the back center, the tendency of the counterweight action is to considerably increase the pressure on the main bearings, and when moving from the forward center the tendency is to correspondingly decrease it. These actions of course culminate when the crank is vertical, or at about half stroke.

This action seems, to some, a sufficient cause for condemning the practice of completely balancing engines. It appears to them that the action is virtually about the same as if there were no modification of pressures on the crank-pin and main bearings by inertia, and it is considered that the additional strain on the main bearings and foundation more than neutralize the gain in freedom from horizontal vibration.

Particular cases will doubtless occur. Some engines are set where much vertical vibration would be dangerous, and of course such cases must be decided by the builder or designer. Taking the ordinary case, where an engine is to stand on a fairly good brick or stone foundation, as the most pertinent to this discussion, it may be said First, that a large number of the best engines built are perfectly balanced (that is, as near as can be), and experience shows that they do not strain their foundations seriously, and that the main bearings run cool, with as little oil as any engines of that class, balanced or not. Second, that a well-built foundation is as solid as the earth, and, if the bolts are well anchored, the engine cannot lift without taking the whole thing. The wear and tear is certainly not near as great as with a horizontal vibration in any case. Third, the question of the effect of "excessive" balancing on the main bearings is not so certain a matter as it appears at first. The way the main bearing of an engine acts, depends on more than one thing, and that ever-present *coefficient of friction* is made up of a great many more factors than are always taken into account. The difference between a cool running journal and a hot running one is often hard to see, if we look for only the standard and well understood essentials to cool running.

The action of a journal depends on the following conditions (among others):

1. The shape and size of journal.
2. The weight it has to carry per square inch of *projected* area.
3. The conductivity of the metal or alloy from which the boxes are made.
4. The alignment of the shaft.
5. The velocity of rubbing.
6. The nature and amount of lubricant.
7. The provisions made for the uniform and constant distribution of that lubricant.

These are not all, by any means, but they are some of the most important, and one of the very most important is the last. It is very frequently the case that the only difference between a cool and a hot running journal is in the size of the oil channels cut in the boxes.

I have diverged somewhat in order to bring out these facts before considering the probable effect of intermittent pressure at the main bearings. I will now return to the point, and throw out a suggestion. The crank-pin is commonly considered the most abused journal on an engine. Its service seems, at first sight, very trying, and yet it is a curious fact that it stands the strain better, and gives less trouble than several other journals about an engine, whose duty seems much lighter. *It may be*, and it does not seem altogether unreasonable to suppose that the shifting of pressures on its surfaces may give a better opportunity for the oil to distribute itself. This is what I want to bring out, and in case of the main bearings, it is not at all improbable that the slightest lift of the shaft of a pulley-balanced engine may help the oil distribution. It is certain, at all events, that many good builders, having their main journals carefully proportioned, do not hesitate to balance to the full extent, and get excellent results, both as to smooth running and freedom from heating.

This does not mean that *all engines* should be, or can be fully balanced, that is, conformably with good practice. I fully believe that carefully built center crank engines should, as a rule, be so balanced, but there are many reasons why a side crank engine cannot be safely balanced to the same extent.

When they are self contained or made so by a solid sub-base, the balance can be carried quite far, but when an independent outboard bearing is used, any lift at the main journals will be very detrimental. Then again, in order to balance fully, the crank disk would in many cases have to be so large as to be clumsy, and the actual benefit would hardly pay for the trouble and expense. A counterweight of about $\frac{5}{8}$ the weight of reciprocating parts gives good results in practice, at speeds from 150 to 280 revolutions per minute, and somewhere in this immediate vicinity, will usually be found the best proportions, or the counterweight may be so proportioned as to result in equal disturbances, horizontal and vertical, according to the methods previously given.

A serious fault with some of the representative side crank engines, is the lack of metal in the bed. This is largely a commercial matter, and a mere question of dollars and cents in first cost; but there is no doubt but that balancing could be much more easily done in many cases if the amount and distribution of metal in the bed were more carefully attended to.

Steel Fire Boat, "The New Yorker."

The steel fire boat, "The New Yorker," built for the Fire Department of the City of New York, was successfully launched at the yards of the Jonson Foundry and Machine Co., 118th street and Harlem River, New York.

The following are some of the principal dimensions of the hull:

Length over all, 125 feet 5 inches.
Length on L. W. L., 115 feet 0 inches.
Beam moulded, 26 feet 0 inches.
Beam over all, 26 feet 11 inches.
Beam on L. W.L., 25 feet 2 inches.
Deep-load draft extreme, 10 feet 0 inches.
Depth moulded at frame 42, 14 feet 6 inches.
Displacement to L. W. L., 351 tons.
Displacement per inch at same, 52 tons.

The keel is made of the best hammered iron, 6 inches deep, and $2\frac{1}{4}$ inches thick.

The stem forging is made of the best hammered iron in one piece, $7\frac{1}{2}$ inches deep from sheer to about the 3d water line, and $2\frac{1}{2}$ inches thick, and tapers uniformly from this to $2\frac{1}{4}$ inches by 6 inches at after end, where it is scarphed and riveted to the keel. The stem is treble-riveted to all plates, and the forward edge worked flush with plating.

The stern forging is also made of the best hammered iron, comprising in one piece the post, shoe scarph, rudder post scarph, also, the bosses for the propeller shaft and rudder stock. The portion of the forging between rudder post and propeller shaft is 3x7 inches; in shaft boss, 3x9 inches; below the boss, $2\frac{1}{2}$x6 inches; in rudder stock boss, $2\frac{1}{2}$ x7 inches. The whole is treble-riveted to plates.

The frames are placed 20 inches from center to center throughout; they are made of steel angle irons, 3x$2\frac{1}{2}$ inches, and $\frac{5}{8}$ inch thick for three-fifths of the length amidships; and 3x$2\frac{1}{2}$ inches by $\frac{5}{16}$ inch thick at ends. They extend from keel to sheer stringer in one piece. From the 14th to the 56th frame, both inclusive, the frames are butted over keel, and fitted back to back with an angle iron 3x$2\frac{1}{2}$ inches x $\frac{5}{8}$ thick, and $3\frac{1}{2}$ feet long, having the floors between and securely riveted through. The frames are double on the bulkheads, and on every alternate frame between the 37th and 56th frame.

Reverse angle irons are made of steel, $2\frac{1}{2}$ x$2\frac{1}{2}$ inches x $\frac{5}{16}$ inch thick in one piece, extending along tops of floors, and 6 inches beyond the bilge stringers on each side, and to sheer stringer alternately. Reverse angles to be double on floors $\frac{7}{16}$ inch thick.

"Rider plate" keelsons are made of steel 20 inches wide, and $\frac{7}{16}$ inch thick in long lengths, butted and strapped with $\frac{7}{16}$ inch plate, and treble-riveted. These keelsons extend on middle line throughout bottom, and are securely riveted to all reverse angle irons, and to bulkheads by short double angles. The keelsons are laid flat on reversed angles, $\frac{3}{4}$ inch thick in wake of engine and thrust, and tied at forward and after ends of tanks by heavy bracket plates and double angles. Intercostal plate keelsons are made of iron. Under engine, fire pumps and thrust, they are $\frac{7}{16}$ inch thick; four plates in each bay; and under boiler they are $\frac{5}{8}$ inch thick, and three plates in each bay. From the 12th frame to stem, and from the 57th frame to stern, the intercostal plates are $\frac{3}{8}$ inch thick and are fitted between each frame on the center line, strongly secured to stem forging, and riveted to floors by double angle irons $2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{5}{16}$ inch. All intercostal plates have large hand-holes cut in their centers, to facilitate the cleaning, and whitewashing or painting bilge. Watercourses are left at the lower corners.

Engine and thrust keelson plates of iron $\frac{3}{4}$ inch thick; countersunk rivets. These plates are made in one length fore and aft. Boiler keelsons are $\frac{1}{2}$ inch thick, 12 inches wide in four plates laid flat and run over tops of floors in wake of tanks. The tops of water tanks are made of steel plates $\frac{1}{4}$ inch thick, riveted to all reverse angle irons, to side plating, to boiler keelsons, and to rider plate keelsons, all in a water-tight manner. This top is provided with suitable manholes and plates, giving access to pockets in tanks for inspection and cleaning.

The bilge stringers are made of steel angle irons 4 x 3 inches x $\frac{7}{16}$ inch thick, placed back to back continuous from stem to stern. These stringers come down to about the 4th water line amidship, and rise at the ends.

The side stringers are made double, of steel angle irons of the same size as the bilge stringers. They are placed about on the 10th water line amidship, and rise fore and aft.

There are eight iron bulb deck beams 7 x $3\frac{1}{2}$ x $\frac{5}{8}$ inches. The full intermediate beams are of angle iron 5 x 3 x $\frac{5}{8}$ inch. The beams in bow and stern, also the beams in wake of fore and aft channel irons, are made of angle iron 4 x 3 x $\frac{5}{8}$ inch. The sheer stringers are 30 inches wide for three-fifths of length amidship, tapering to 24 inches at ends; they are made of steel $\frac{5}{8}$ inch thick.

The beam ties are steel plates 24 inches wide by $\frac{5}{16}$ inch thick, fitted on center line forward and aft of trunk, running to the ends of vessel. Around the house they are 12 inches wide, $\frac{5}{16}$ inch thick. They are all riveted to deck beams at every crossing.

There are four full water-tight steel bulkheads $\frac{1}{4}$ inch thick, extending from floors to deck beams; and four partial bulkheads. The bulkheads for bunkers are $\frac{3}{16}$ inch thick, and worked dust-tight.

The plating is of steel, placed "in and out," the thick strakes are on the outside. Garboard and sheer strakes 30 inches wide, $\frac{1}{2}$ inch thick. Strakes between are $\frac{7}{16}$ and $\frac{5}{8}$ inch thick, alternately, except that on bow from about the 9th water line, down and aft as far as frame 9, all plating is $\frac{11}{16}$ inch thick.

Riveting in $\frac{5}{16}$ inch plates, $\frac{3}{4}$ inch rivets
" " $\frac{1}{2}$ " " $\frac{7}{8}$ " "
" " $\frac{5}{16}$ and $\frac{5}{8}$ " $\frac{5}{8}$ " "
" " $\frac{7}{16}$ and $\frac{1}{2}$ " $\frac{3}{4}$ " "

For heavier plating in stem and stern pieces, $\frac{7}{8}$ and 1 inch rivets are used. Deck is made of 3 inch white pine, and cabin floors $1\frac{1}{2}$ inch white pine tongued and grooved.

For the fire pump suctions, there are arranged large plate iron suction boxes, one on each side of vessel. Each of these suction boxes have openings and connections to the skin plating in three bays; in wake of these openings, the skin plating is made into a strainer, by drilling $\frac{1}{2}$ inch holes through it; the combined area of the $\frac{1}{2}$ inch holes opening to each box, is not less than 1,000 square inches. A valve and internal pipe $1\frac{1}{4}$ inch diameter, with nozzle in each bay, is arranged for clearing strainer plates with steam jets. Each suction box has two 16-inch diameter straightway gate valves riveted to it, ready to receive pipe flange.

The engines for propelling the boat are of the triple-expansion type, direct overhead acting, with the three cylinders side by side on a fore and aft line. Cylinders, 15x24x39 inches diameter by 24 inches stroke. Number of revolutions, 135; boiler pressure, from 135 to 150 pounds. Main screw propeller, 7 feet 9 inches diameter, 12 feet pitch (true), with four cast-iron blades. Besides this propeller the boat is provided with Kunstadter swiveling screw and gear. This screw is 7 feet 9 inches diameter, and 13 feet 6 inches pitch (true), four blades.

The surface condenser contains 2,000 square feet of cooling surface on seamless brass tubes, and serves for the main engine and pumps.

Messrs. Brown & Miller, of Jersey City, have built the main engines and machinery connected with it.

The boilers are in the course of construction in the shops of McNeil & McLaughlin, at Greenpoint, N. Y. There are two cylindrical boilers of the Scotch type, with four internal flue corrugated furnaces and return fire tubes.

Diameter of shell, 12 feet; length over all, 15 feet; diameter of furnace flue over corrugations, 42 inches; length of furnace flue, 12 feet 9 inches; length of grate, 7 feet. 204 tubes, $3\frac{1}{4}$ inches inside diameter, 12 feet 9 inches from outside of tube sheets. Outside shell, $1\frac{3}{8}$ inch thick; furnace flue, $\frac{1}{2}$ inch; front and back head, $\frac{9}{16}$; sides and back connections, $\frac{7}{16}$; tube sheet of back connection, $\frac{9}{16}$; shell of steam drum, $1\frac{3}{8}$; and heads of steam drum, $\frac{7}{16}$ inch thick.

There are four sets of fire pumps of special pattern and extremely high power. Two sets are being manufactured by the Clapp & Jones Company, of Hudson, N. Y., and two sets by the La France Fire Engine Company, of Elmira, N. Y.

The pumping machinery will throw four four-inch streams, or two five-inch streams, with modifications to meet the need.

The boat is expected to be ready for service about next June, and is expected to be the most effective engine for the extinguishment of fire in this or any other country. It is likely that she will be stationed at the Battery, so that she can run up the East or North River with equal celerity.

She will be supplied with all the signals and alarms that are commonly set up in the engine houses on shore, and the signals may be received and transmitted to and from her, precisely the same as in land engine houses.

She will be, in fact, an immense movable pumping engine, capable of being transported rapidly and on a moment's notice to any point on the river front where her services may be required. The designer of this boat is Mr. William Cowles, Constructing Engineer and Naval Architect, 45 Broadway, New York.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

Horace B. Miller, Pres't and Bus. Manager.
Lycurgus B. Moore, Treas. and Sec'y.

F. F. Hemenway, Editor and Mech. Engineer.
J. G. A. Meyer, } Associates.
Fred J. Miller, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$2.50 a year in advance, postage prepaid in the United States, Canada, and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, APRIL 10, 1890.

CONTENTS.

PAGE

A Method of Extending the Range of Cut-off and Compression in Corliss Engines. By James B. Stanwood 1, 2
Practical Details of Blacksmithing. By B. F. Spalding 2
"Tapers"—Reply to a Mechanic. By Jarno 3
The American Patent System. By D. Walter Brown 3
A Boring Tool 3
Fink Swindles a Thread Mill 3
Literary Notes 3
Stress in Structures 4
Reduction of Indicator Diagrams 4, 5
A Safety Lantern 5
Beveling Shear 5
Letters from Practical Men: Belting. By Samuel Webber—The Decimal System—Emery Wheels. By Fred H. Colvin—Grindstones and Emery Wheels. By F. F. D.—Building and Loan Associations. By James F. Hobart—Amateur Engineering. By Bax—Section Liner. By Arvid Levin—Inspection and License Law. By J. F. B.—Elevating Tool Rests. By Fay 5, 6
Force in the Steam Engine and its Relation to Smooth Running. By Prof. Joseph Torrey 7
Steel Fire Boat, "The New Yorker" 7
Cost of Building Machinery Here and in Europe 8
Patents and Monopolies 8
Questions and Answers 8, 9
Manufactures 9
Machinists' Supplies and Iron 10

Cost of Building Machinery Here and in Europe.

We believe that a good many Americans who visited Europe last summer, mainly on account of the Paris Exposition, came home impressed with the fact that moderate sized machine tools and steam engines can be built for just as little money here as there, notwithstanding it is true that wages, by the day or hour, are very materially in favor of the American workman. Actual observation leads us to believe this to be true, and we believe this to be the opinion of impartial observers.

Some of the reasons for this are plainly to be seen. No moderately close observer has failed to arrive at the conclusion that workmen work harder—a good deal harder—here than there. Just why this is so, is not easily explained. It is quite generally assumed that climatic influences have a good deal to do with it. Business of all kinds goes a good deal more by bustle and under high pressure here than in Europe, and this spirit of—let us say unrest—influences in America the manufacturer and his workmen alike. Then the inclination to *crowd* workmen more here than in Europe is plainly apparent. In Europe the workman has certain prerogatives that no one tries to set aside. And one of these prerogatives is to do only a definite amount of work in the hours devoted to working.

Again, higher wages here undoubtedly have something to do with the matter. It is a fact that cannot be gainsaid, that money—the hope of recompense—brings out the best there is in men. And it is a generally observed fact that, in the trades where a high degree of skill is required—such as trades connected with the manufacture of machinery—high-priced labor is the cheapest.

In the machinist's trade, and in those trades intimately connected with it, taking wages at the average in all countries, we believe there is no country in the world where the day workman earns—judged by what he produces—his wages as well as he does in America. We know that this is not the generally received opinion in this country, but nevertheless we believe it to be true. And this is not only our own observation in the matter, but it is the opinion of every American with whom we have talked, who has had experience in paying for machine work done in this country and in Europe.

There is probably a good deal of truth in the remark made to the writer by a manufacturer in England, to the effect that English workmen preferred doing less work, and receiving correspondingly less wages, to working under high pressure, and wearing themselves out in fewer years, for the sake of having a little more money to spend. On the whole, European workmen, more especially English workmen, appear to be much better contented with their lot *as workmen* than mechanics in this country. And in no country in the world are their rights—or what they consider to be their rights—more secure than in England.

In the manufacture of the smaller parts of machinery, the more complete system here, and the more general employment of special tools and devices, is in favor of the American manufacturer, and this quite balances other disadvantages than those named.

So much for medium sized and small machinery, in the line of machine tools and steam engines. In such work, in the opinion of the writer, the United States, with the price paid here for labor, can compete with the world in point of actual cost. If more is paid here for labor, labor produces at least correspondingly more. Beyond this the American product will not suffer by comparison. A little finer work is done in these lines of work in some parts of Europe than is done here; but American workmanship is up to the demand, and is likely to keep pace with that demand. If England alone is considered, then we believe America is ahead in workmanship. From this, locomotive engines may be excluded. We believe in the American type of locomotive, but frankly admit that, as a machine, the English locomotive is, if anything, better built than ours are.

In textile machinery there is good evidence that, considering quality, European manufacturers are ahead. The immense textile interests of England have created a demand for textile machinery, that has stimulated competition in its manufacture to a remarkable degree. Such machinery—for fine work—cannot, as yet, be made in this country to compete with corresponding machinery of English manufacture. This is the fault of the manufacturers here; not of the mechanics.

In the manufacture of heavy machinery we have much to learn. We hardly, as yet, know how to handle such machinery in its manufacture. A better knowledge must come from experience; at the present, England is a good ways ahead of this country.

One thing that, more than any other, bars progress in the machinery business in this country, is the idea that we can do everything better here than it can be done elsewhere. We do a good many things very well indeed, and some things better than they are done elsewhere, but it is an excellent educator to find, as many an American did last summer, that they do these same things very well indeed in other parts of the world.

Patents and Monopolies.

There is one great American industry, which, though it was in a flourishing condition a few years ago, seems to have declined, until we hear comparatively little of it in these days. This industry had no particular location, but flourished in all parts of the country, and was carried on by smooth-tongued individuals, who drove about among the farmers, and swindled them in various and ingenious ways, too numerous to mention. In many of the tricks by which this was done, patented machinery of various kinds played an important part, though the facility with which the shekels of the guileless agriculturist were obtained by tricks involving the pretended purchase of chickens and similar things, showed that machinery or patents were not considered by the operators to be a necessary feature of the business. Nevertheless patent rights figured in these transactions sufficiently to give many of the farmers the idea that the whole patent business was nothing more nor less than a gigantic scheme to enable sharpers to swindle them. Inventors became in their eyes mere cormorants, or blood-suckers, that the community would be well rid of, and now that it has become plainly apparent that something is the matter with the American farmer, he is inclined to lay it partly to patents and inventors.

A convention of farmers recently held in the West, demanded that the rights of patentees in new inventions should be limited, and the time of their exclusive privilege shortened. There is among other classes of people, also, a disposition to attribute many of the real and imaginary evils which afflict us to the same cause; but that things would be helped by a curtailment of the present rights of inventors and patentees, we cannot believe.

It is undoubtedly true that patents are in many instances made use of as a help in extorting money from the public, for which no fair return is made, but it by no means follows that relief would be obtained by striking at inventors. Plenty of the most oppressive monopolies with which we are afflicted are not founded upon patents at all, but would go right on, and flourish, were all patents abolished. With the facilities for forming monopolies, which seem to be furnished by our social organization, it is difficult to mention any features of that organization which may not be made a means for increasing the power of monopoly. The greatest monopolies have their origin, not in the lack of legislation to protect the people, but in legislation which is intended to and does actually give an advantage to one citizen or class of citizens over others. Let the farmers and others who complain of the oppression caused by patent rights, look about them, and see who it is that has all the good things of this life, without performing the least service of any kind in return therefor. When they have found these persons, and noted the basis upon which their privilege rests, there may be less disposition to complain of the comparatively small amounts made out of patented inventions. For it is always to be remembered that the granting of a patent gives a monopoly of the one thing patented only, and that thing is a something which the world up to the time of the granting of the patent has been getting along without, and not only can, but will continue to get along without, unless terms can be made with the inventor, which are mutually advantageous. The patenting of the reaping machine did not destroy the cradle nor render it any less effective as a harvesting implement. Any farmer who chose could continue to cradle his wheat, and would actually do so, unless he could obtain a reaping machine upon such terms as made it advantageous to him. And any farmer who chooses can hire men to bind his wheat instead of using a self-binding reaper, and every one of them will do it unless he can obtain the self-binding machine upon terms which are advantageous to him. He will not pay to the inventor and manufacturer of the machine all the advantage which he gains by its use, and it is plain that he would not do so, even if there were but one manufacturer of such machines, and therefore no competition, because, rather than do this, he will continue to do his harvesting in the old way, and will do so until the price at which the machine is offered enables him to profit by its purchase. The same principle will be found to apply to every patented invention. No patent gives to its holder a monopoly of any natural substance or product, nor of any opportunity for the application of wealth-producing labor which existed before the patent was granted. It gives a monopoly of that only, which before was not in existence, and which men not only can but will do without, unless they can obtain it by a payment to the inventor or his assigns of something less than the advantage to be gained by its use.

It must be plain, therefore, that for the privileges granted to an inventor by our patent laws, he must return more than a full equivalent to the community in every case except where his invention passes into the hands of a company powerful enough to monopolize its advantages, in which case the thing to contend against is the condition which favors the formation of such monopolies, not the inventor. In fact, it has been shown in numerous instances that new inventions constantly coming into use, and which it is fair to assume are stimulated by the security offered by the Patent Office, are the most effective check upon monopolistic operations, and gave the best means of successful competition with them.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(134) C. R. J., Keokuk, Iowa, asks: Will a pressure gauge attached to the bottom of a stand-pipe 1 inch diameter, 50 feet high, show the same pressure as when it is attached to the bottom of a stand-pipe 50 feet high and ¼ inch diameter? Both pipes are filled with water. *A.*—Yes.

(135) H. S., Chicago, Ill., writes: Please give us a decision to settle a dispute which has arisen in our shop. A. claims that in a set of three taps all three are to be the same diameter. B. claims that the first (taper) tap should be smallest, the second a little larger, and the third the largest, while C. claims that his experience with taps bought from the manufacturers shows that the third tap is the smallest one. Which is right? *A.*—We think it is the usual practice to make the second and third taps the same or standard size, and the first one slightly smaller. Sometimes, however, all three are made the same size, and

sometimes they gradually increase in size from No. 1 to No. 3. We are quite certain, however, that the No. 3 tap is never made smallest designedly; when it occurs it is probably an error.

(136) E. M. D., Rockwood, Tenn., writes: Please give me a rule and example for finding the size of iron rods in a truss roof. *A.*—Make a diagram of the truss, and find the stress on each rod, as explained on page 570 in Trautwine's Engineer's Pocket Book, eleventh edition. After the stress has been obtained, make the cross-sectional area of the rod so as to give a stress of not more than 10,000 pounds per square inch of section.

(137) H. K., Bloomfield, N. J., asks: Will you kindly suggest some way for preventing water-proof drawing ink from clogging in the pen? *A.*—We see no other way than by cleaning the pen thoroughly as soon as clogging commences, and then taking a fresh supply of ink. If with this precaution the ink will not flow, and it has been kept free from dust, we should procure a better quality of ink. 2. What is the pressure per square inch in a bowl 12 inches diameter, running seven thousand revolutions per minute? *A.*—We do not understand your question. If you mean the stress per square inch due to centrifugal force, we need to know the material of which the bowl is made, and its thickness.

(138) J. A. S., Lansing, Mich., writes: Please tell me of a remedy for a shaking boiler. We have several engines running where the boiler shakes or vibrates all the time when the engine is working. *A.*—You do not state what type of boiler you are using. Sometimes boilers shake for the want of sufficient steam room; in cases of this kind the water level must be lowered, or, if this cannot be done with safety, you will have to procure boilers properly constructed for the work they have to do. But we are inclined to believe that you are using horizontal cylindrical boilers, with the grates underneath. These boilers are probably supported by three brackets on each side. If now the boilers are too small for the legitimate work they have to do, and the fires are forced, or, if the circulation is bad, the expansion of the bottom of the boiler will be so much greater than the top as to lift the end brackets off their seats, leaving the center brackets as the only supports for the boiler, giving it the required conditions for vibrating when the engines take steam. The remedy is obvious—support the boiler on two brackets on each side, do not drive the fires, and, if possible, improve the circulation. In any case, vibration of boilers indicates danger, and calls for an immediate and thorough examination to locate the trouble.

(139) W. H. C., Chicago, Ill., writes: Please tell me whether I have the correct answer for the following problem: How long will it take a railway train to travel 100 miles, traveling 50 miles the first hour, and then reducing the speed for every hour to one-half the speed of the preceding one, until the 100 miles are completed?

1st hour	....	50	miles.
2d "	.....	25	"
3d "	.....	$12\frac{1}{2}$	"
4th "	.....	$6\frac{1}{4}$	"
5th "	.....	$3\frac{1}{8}$	"
6th "	.....	$1\frac{9}{16}$	"
7th "	.....	$\frac{25}{32}$	"
		$99\frac{7}{32}$	"

I now say to myself, I have $\frac{25}{32}$ of a mile more to travel to complete the 100 miles; the train traveled this much in the seventh hour, therefore at half the speed it will take just twice as long to travel this $\frac{25}{32}$ of a mile as it did in the seventh hour, or two hours to travel this $\frac{25}{32}$ of a mile, making a total of nine hours, which is the answer. *A.*—You have commenced correctly to solve the problem, but have gone astray at the end. According to the conditions of the problem you should continue as you have commenced; for instance, the train travels in

7th hour	.....	$\frac{25}{32}$	of a mile
8th "	.....	$\frac{25}{64}$	" "
9th "	.....	$\frac{25}{128}$	" "

and so on. The correct answer to the problem is: The time to travel the 100 miles is infinitely great. It will never get there.

(140) J. S. B., Ithaca, N. Y., writes: We have a small launch on the lake here, with a three horse-power engine and boiler. We feed water through a Hancock inspirator; for some reason the inspirator is not positive, and we desire to put in an auxiliary feeding apparatus. If we put in a pump, would it be injurious to feed the water directly to the boiler? Ought not the inspirator work better? *A.*—The inspirator should work better. We should advise you to write to the makers; they will undoubtedly take pains to make the inspirator work satisfactorily. To supply the feed water with a pump will not be injurious to the boiler, provided the feed water is not allowed to impinge against the sheets which are highly heated. We prefer the inspirator because it will supply the boiler with feed water at a higher temperature than a pump. 2. How often and how much should we blow off? The water is very good, very little lime, etc., but sometimes quite muddy. *A.*—The amount to be blown off, and the time at which the water should be blown off, will depend on the condition of the water. We should blow off once or twice a day through the bottom blow-off cock, when the engine is standing still and the mud had time to settle. When the engine is running we should use the surface blow two or three times a day. As to the amount to be blown off, good judgment must be used. When the engine is running the water in glass gauge should be as clear as circumstances will permit. 3. What is the best prevention of scale in a vertical fire tube boiler? *A.*—Try a small quantity of kerosene. 4. Can you recommend a book on the care of such boilers? *A.*—Steam Boilers, by W. H. Shock, is a good book.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Crank pin Machines. Pedrick & Ayer, Philadelphia, Pa.

Planer Chucks—Greenwood's Universal. Pedrick & Ayer, Philadelphia, Pa.,

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Whiton's Chucks. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Duplex Gear Cutters kept in stock from 4 to 36 pitch, and warranted. R. M. Clough, Meriden, Ct.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

Steel Name Stamps, etc. Address W. G. Sackmann, 1099 First ave., Cleveland, O.

Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 18th st., New York.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

The Sure Grip Steel Tackle Blocks must fill the bill, according to the large sales reported. See advertisement, page 13.

Watch this column for our Weekly Announcement of Bargains. Selling Overstock. McFadden Co., 1025 Market st., Philadelphia, Pa.

25" Upright Drills a specialty. Finely made, 28" great capacity, quickly operated, prices low. 32" Send for list of firms using our Drills. J. E. 36" Snyder, Worcester, Mass.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Patents.—Patent soliciting of high class. D. Walter Brown, 31 Nassau st., New York. Send for "A Brief History of Patent Legislation in the United States."

C. H. Redman & Co., Newark, N. J., Manufacturers of Light Machinery, Automatic Selling Machines, Telephone and Telegraph Instruments, Sewing Machine Attachments, Models, etc. Contracts solicited.

For Sale—Bound volumes of the Patent Office Gazette for years 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per volume. Address J. C., care of American Machinist.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations. 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

The Lexington Gear Works, of Lexington, Mass., have issued a Catalogue of some six hundred sizes of Cut Iron Spur and Bevel Gear Wheels. Every machine or manufacturing concern in the country should send for a copy.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

The Prize Designs for Pumping Stations are suggestive to those about to build a Boiler House or Electric Light Station. Six months' subscription ($2) to *The Engineering and Building Record* will secure the 17 selected designs, also the Prize Essays on Road Making and Maintenance. 277 Pearl st., New York.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller. Propellors of same patterm and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices. Consulting Expert and Construction Engineer. Estimates made on machinery and on damages.

Just concluded. "Practical Drawing." By. J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Modern Locomotive Construction." By J. G. A. Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

MANUFACTURES

The Detroit Electrical Manufacturing Co. will build works at Detroit, Mich.

The Indianapolis Car Works have orders for 1,000 freight cars for the New York, Ontario & Western road.

The Dwight Cotton Mfg. Company, Chicopee, Mass., has awarded the contract for building a two-story addition.

At Bluffton, Ala., a $200,000 stock company is being organized to build a rolling mill. The sum of $125,000 has been subscribed.

A company to manufacture tacks has been organized at Pittsfield, Mass. Col. Walter Cutting is president of the company.

The foundry and machine shop of T. H. Brooks & Co.'s architectural iron works, Cleveland, O., recently destroyed by fire, will be rebuilt at once.

The Lewiston (Me.) Board of Trade is making an effort to buy up the Lincoln mill property, with the intention of fitting it up for small manufacturing purposes.

The Fisher Manufacturing Co., Fisherville, Mass., will erect an addition to their large cotton mill, 172x95 feet, four stories high, of brick, and double the capacity of the present mill.

A $100,000 compress and oil mill has been organized at San Antonio, Tex., and is only awaiting a charter to begin operations. A location has been secured, and work will begin at once.

The United States Sash Pulley Machinery Company, St. Louis, Mo., has incorporated, with a capital stock of $50,000. The incorporators are H. C. Stiefel, J. L. Winkelmeyer and Edward Hills.

Westfield, Mass., has long been noted for its whip manufactories. Now it is said that the manufacturers there have formed a syndicate, the principal object being the reduction of the cost of selling.

The Wiley & Russell Manufacturing Co., Greenfield, Mass., has issued a March supplement to its regular catalogue. The supplement—single leaf—contains cut and description of the "New Lightning Screw Plate" and Taps.

The Buffalo Steam Pump Co., Buffalo, N. Y., is building a compound high-pressure pump, to work with 160 pounds steam pressure against 2,000 pounds pressure. This firm is quite busy and reports prospects very bright for the coming season.

The Cardiff Coal and Iron Company, Cardiff, Tenn., will start a new town on the land owned by it. This company owns several thousand acres of mineral and timber land. It is expected that the company will institute several large manufacturing industries.

The Illinois Bolt and Nut Company, of Peoria, Ill., has perfected its incorporation with a capital stock of $100,000, and will at once enter upon the manufacture of nuts and bolts. The incoporators of the new company are J. S. Stevens, G. J. Gibson and L. E. Mague.

The Allentown Foundry and Machine Company, Allentown, Pa., has issued a new illustrated catalogue of the Eureka turbine made at the works. In addition to cuts and description of wheels, the catalogue contains useful information for millwrights and others.

The Cleveland Twist Drill Co., Cleveland, Ohio, recently made a spiral profiling cutter, five inches diameter and seventeen inches long, with a two-inch hole through it. The cutter was made from solid metal, and weighed 102 pounds in the rough. It was perfect in every respect.

The Braddock Wire Company, of Braddock, Pa., in which John W. Gates, of the St. Louis Wire Mill, also has a large interest, is laying a gas line from its works to Sandy creek, near the Allegheny river, where it connects with another pipe line. The branch line will be four miles long.

The N. O. Nelson Manufacturing Company, of St. Louis, are negotiating for an extensive manufacturing site at Edwardsville, Ill., to consist of over 200 acres. In case they secure the site, the Nelson company will establish a large foundry, and various other manufacturing departments.

At its recent town meeting, Wiscasset, Maine, voted to exempt from increased taxation for a period of five years the following industries: Kindling Wood Mill, Sowther's Brick Works, Wiscasset Shipbuilding and Navigation Co., and any other enterprise to the amount of $2,000 which may be started for the public good.

The contract has been let for the erection of the new lead works of W. G. Price & Co., of Pittsburgh, Pa., to be located at West Jeannette. The works, when completed, will cover fully two acres, and will be built of stone and corrugated iron. The respective size of the main buildings will be 182x51 feet, with an 80-foot wing, 350x80 feet, and 130x40 feet.

A leather firm is to occupy the lot adjoining the Worthley shoe factory at Lynn, Mass., and a new morocco factory will be erected, four stories in height, main building, 50x180 feet; boiler house, 13x35 feet; and beam house, 50x60 feet. There will be 237 large-sized windows in the main building. Machinery will be put in to manufacture Dongola goat, sheep and glove calf. The plant will be owned and operated by A. B. Hoffman.

The little unpleasantness between England and Portugal is an ill wind that blows some good to this part of the globe. Messrs. Hussey, Binns & Co. [Pittsburgh, Pa.] are in receipt of a good-sized order, from Lisbon, Portugal, for shovels, which is thought to be the result of the boycott of English goods by the Portuguese. The firm has also, within the week, received orders for shovels from Chili and Yokohama, Japan.—*American Manufacturer.*

Owing to the large increase in their business of late, P. Bartlett & Son, hosiery manufacturers at Milford, N. H., have purchased the mill formerly occupied by the Novelty Works, located near their present factory, where they will at once put in two new sets of carding machines, and other machinery, increasing their output 100 dozen pairs of hose per day. They also contemplate establishing a manufactory of underwear. Their new mill is 30 by 100 feet, four stories high, furnished with steam and water power.

The following from the *Duluth* (Minn.) *Daily Tribune* shows the progress being made at the wagon works at South Superior: "William B. Tyler, representing the Buffalo Forge Company, of Buffalo, N. Y., has closed a contract with the South Superior Improvement Company for heating apparatus for the wagon factory. The hot blast system, employing immense fans for the distribution of heated air, has been adopted. The dry kilns will be heated by the same system also. The blacksmith shop will be furnished with a complete system of forge blowers and smoke exhaust, by which means the gas and smoke, which will naturally accumulate, will be driven through an outlet. The wood-working machinery will be connected by piping direct with the furnaces."

The Hussey Re-heater and Steam Plant Improvement Company, of 15 Cortlandt st., N. Y. City, has just completed the fitting up of the new mill of the Nashua Card and Glazed Paper Co., at Nashua, N. H., where they have put in the entire piping of the mill on plans designed by them, and applied their Hussey re-heater system to the same, by means of which not only the heating of the mill in winter, but also the heating required for the various drying processes (for which it has hitherto been considered necessary to use live steam in similar establishments) are performed with exhaust steam from the engines and pumps, re-heated by their process. The mill is now in operation, and the Hussey re-heater system, and the entire heating apparatus as designed and erected by the above company, are giving, we are told, the highest satisfaction to its owners. The same company have just received an order for fitting up the new woolen mill being built at Chester, Pa., for Messrs. Geo. C. Hetzel & Co., of Philadelphia, in which their Hussey re-heater system will be applied to the utilizing of the re-heated exhaust steam for the various processes of boiling, dyeing, drying, etc., for which exhaust steam in its normal condition is unavailable, and for which, without this system, live steam would be required.

C. R. Carley, Syracuse, N. Y., has recently brought out an electric photograph burnisher. It is of the well-known rotary type, and consists principally of two ends or frame-work supporting two hollow steel rolls, the upper one being knurled or milled, and the other one highly polished. The two rolls travel in the same direction, but one is geared so as to revolve faster than the other, thereby causing friction enough to polish the picture. A single hand wheel is used to adjust the rolls to suit any thickness of card. All of the bearings are made of anti-friction plumbago metal, and will run for years without oil. This is a strong point in this machine, as a single drop of oil or soot will spoil any photograph. The heating apparatus consists of a resistance coil of German silver wire, and is placed inside of the lower or polishing roll, and thoroughly insulated from it. It is so arranged as to be removed easily from the roll if at any time it should become necessary to do so. Simple binding posts serve to make connection with the outside current. A suitable rheostat is placed under the rolls, or near the machine in any convenient place, and, by simply turning a small lever, the heat is regulated to suit the work, or entirely shut off, as the case may be. By this process of heating the roll is kept constantly at the same temperature the entire length, and will heat in five minutes up to 250 degrees Fahrenheit. It works equally well when connected to a storage battery, and will heat just as quickly.

Machinists' Supplies and Iron.

NEW YORK, April 5, 1890.

Iron—American Pig.—Some Southern brands have sold at prices as low as prevailed last summer and prices generally have a downward tendency. We quote standard brands No. 1 X Foundry, $18.50 to $19; No. 2, $17.50 to $18. Grey Forge, $16.50 to $17. Southern irons have sold at $16.50 to $17.50 for No. 1 X Foundry, and $16 to $16.25 for No. 2.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 90 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Good machinists; also a few exp'd scrapers. The Pond Machine Tool Co., Plainfield, N. J.

Draftsman on heavy machinery wants work. Good references. Address "Detail," AMERICAN MACHINIST.

Wanted—Two mechanical draftsmen. Address J. R. Clay, Dayton, O.

Foundry foreman wants a position. Long experience, good references. Foundry, AM. MACHINIST.

Wanted—Position as foreman of machine shop in the vicinity of N.Y. Exp'd in marine, stationary engines and gen'l machinery. Hustler, AM. MACH.

Wanted—Good general machinists to work on Corliss engines, ice and refrigerating machinery. Frick Company, Waynesboro, Franklin Co., Pa.

Wanted—Position as traveling salesman by first class tool maker experienced in general machinery business. P., care AMERICAN MACHINIST.

Mechanical engineer wants permanent position as ass't sup't or chief draftsman. 10 years' exp.: technical education. Good refs. A. B., AM. MACHINIST.

Wanted—May 1, responsible position by 1st-class mechanic familiar with medium and light machine and tool work, and mfg. Connecticut, AM. MACH.

Wanted—A first-class machinist and tool maker. Good pay and a steady job. C. & M., 234 W. 29th st., New York.

Wanted—A number of first-class machinists. A nice shop, steady work and good pay to good men. P. M. Sharples, West Chester, Pa.

A practical foundryman, who understands machine and fine face-work castings, wishes position as foreman. H., AMERICAN MACHINIST.

Machinists Wanted—First-class vise and machine hands of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, Ohio.

Draftsmen wanted who are accustomed to designing power machinery, especially cranes. Address, stating age, experience, references, and compensation expected, BOX 1, AMERICAN MACHINIST.

Wanted—First-class foreman to take charge of large boiler shop. Address, with full particulars—experience, age, salary expected, etc., Henry Warden, Germantown Junction, Philadelphia, Pa.

Wanted—At once, 12 good machinists; also 6 good machinist blacksmiths. Apply by letter, stating experience and wages expected, to Fac. "A," T. H. Electric Co, Lynn, Mass.

Niagara Screw Co., Buffalo, N. Y., about starting manufacture of set and cap screws, want competent man for mechanical charge. Rare opportunity for suitable man. Address above immediately.

Wanted—At once, 1st-class pattern makers familiar with heavy engine and machine work. Steady work and liberal wages guaranteed. Chester Foundry and Machine Co., A. E. Jenkins, Gen'l Manager, Chester, Pa.

Young man (30), thorough mechanic, having successful experience in shop management, wants to make a change. Is an accurate draftsman, and experienced in designing special tools, etc. High class work preferred. BOX 2, AMERICAN MACHINIST.

Wanted—A first-class machinist as foreman in a shop in the manufacturing of dynamos and motors. Must be experienced in handling help and producing goods at the best advantage. Must be A No. 1 at machine work. Electrical knowledge not required. Royal Electric Co., Peoria, Ill.

A member of the A. S. of M. E., with 12 years' experience in the design, construction and management of modern steam plants and general machinery, wishes to correspond with builders in need of sup't or engineer. Best references and reason for wishing to change present location. Address Engineer, care AMERICAN MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d-h'd Lathes & Drills. S. M. York, Clev'd, O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Castings of every description and machinery built. Address Cedar Point Foundry, Port Henry, N. Y.

Inventions perfected; experimental work; fine tools, dies & light mach'y. C. Wadsworth, 90 Fulton st., N.Y.

Wanted—Customers for our new Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Inventions or improvements in measuring instruments & other fine tools wanted to manufacture & sell on royalty. "Tools," AMERICAN MACHINIST.

Simonsen-Walter Mfg. Co., Jefferson City, Mo., with modern foundry, machine and wood-work plant, wants spec. to manuf. for Western trade.

Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To buy partnership in a good machine works, by a mechanical engineer of unquestionable experience in the line of artificial ice machines and refrigerating appliances. ⅓ or ½ interest in a medium works where engines are or can be built, preferred. Address A. AMERICAN MACHINIST.

Wanted—A purchaser for a small Foundry, Machine Shop, Wood Shop and Grist Mill, with 25 H.P. engine and boiler; all in good order; located in Virginia, on a navigable river with a daily line of steamers; surrounded with well-to-do farmers. No other foundry within 30 miles. For further particulars address C. A. Hege, Salem, N. C.

BRADLEY HAMMERS AND FORGES.

The BEST HAMMERS in the WORLD RUN BY BELT.

Over 1500 In Use.

Three Styles, 15lb. to 500 lb. Heads.

Our FORGES heat irons fast enough to keep Hammers and men fully employed.

Send for Catalogue and Prices.

BRADLEY & COMPANY, Syracuse, N. Y.

63 Murray St., NEW YORK. 98 Sudbury St., BOSTON.

TWENTY YEARS WITH THE INDICATOR.

Being a Practical Text-Book for the Engineer or the Student, with no complex formulæ, and with many Rules as to the best way to run any Steam Engine to get the Most Economic Results—How to Adjust Valves and Valve Motions, with Directions for Working up Horse Power—Amount of Steam or Water per Horse Power—Economy of Fuel—Directions for Attaching the Indicator—Motions to Use and Not to Use—How to Compute by Planimeter or Without, etc., etc. By Thomas Pray, Jr., Consulting and Constructing and Civil and Mechanical Engineer, etc., etc. Seventh thousand (1888). Newly arranged and complete in one volume Royal 8vo, cloth.....$3 00

"It is a very thorough work, and appears to be amply sufficient for the guidance of the practical engineer and the information of the intelligent engine-builder or the manufacturer."—*Scientific American.*

JOHN WILEY & SONS, 53 E. 10TH ST., NEW YORK.

◎ FOR SALE. ◎

PULLEY PATTERNS

A set of Iron Pulley Patterns in halves with curved arms. Diameters from eight to twenty by inches, and to forty-eight inches diameter, varying by two inches. 163 in all. No hubs. These have been set aside for some time by our moulding machines, and are offered for sale, low.

Also one set of Hangers; three sets of Mortising Machine; one set of Moulding Machine; two sets of Spoke Lathe; and one set of Upright Shaper Patterns.

THE LANE & BODLEY CO. CINCINNATI, O.

Send $1.00 for *Catalogue D.*

No charge when $10 worth of goods are ordered.

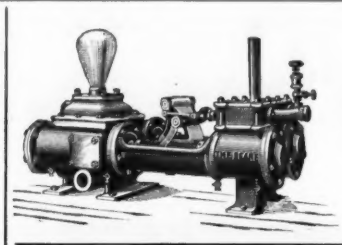
Over 550 pages, fully illustrated.

FRASSE & CO.,

92 PARK ROW, N. Y.

KEUFFEL & ESSER CO.
NEW YORK.
FACTORY, HOBOKEN, N. J.
Manufacturers of
Drawing Materials, Etc.,
Superior Swiss Drawing Instruments. Extra and Best Quality, German Drawing Instruments.
Paragon, Duplex, Universal, Anvil Drawing, Hellos, Blue Process Papers, Scales, Triangles, T-Squares, Drawing Boards, Standard Profile and Cross-section Papers.

Catalogue to professional people on application.



THE DEANE

OF HOLYOKE

STEAM PUMPS

DEANE STEAM PUMP CO.,

HOLYOKE, MASS.

BEST STEEL

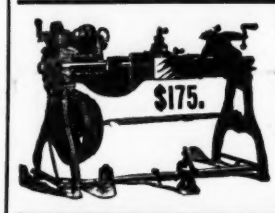
For Taps, Dies, Punches, Milling Cutters, Lathe and Planer Tools, Cold Chisels, Edged Tools and Hardware of all kinds.

CRESCENT STEEL CO.,

136 FIRST AVE., PITTSBURGH, PA.

64 & 66 So. CLINTON ST., CHICAGO, ILLS.

430 PEARL STREET, NEW YORK, N. Y.



Improved Screw Cutting Foot and Power **LATHES**

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

THE SEBASTIAN-MAY CO., 167 W. 2d St.,

CINCINNATI, O.

MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

TOBIN BRONZE

Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
Anti-Frictional and Non-Corrosive.

CAN BE FORGED HOT.

Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Ingot metal for car and engine bearings. Spring wire.

ANSONIA BRASS & COPPER CO.,

Sole Manufacturers.

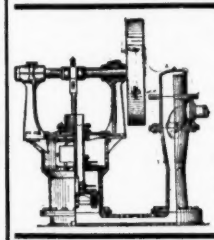
Send for Circular. CHICAGO. NEW YORK.

HENRY CAREY BAIRD & CO.,

INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,

810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.



Belt Power Air Pump and Condenser.

CONOVER & CO.,

CONSULTING AND MECHANICAL ENGINEERS

95 LIBERTY ST., NEW YORK.

No Air Locks 15 to 50 per cent fuel saved or equal amount of power gained. Runs with same economy as engine.

Adapted to all kinds of Engines. *Send for Circular.*

ALUMINUM, $2 PER POUND.

THE PITTSBURGH REDUCTION COMPANY, 95 Fifth Avenue, Pittsburgh, Pa., U. S. A., offer commercially pure aluminum at the following rates at Pittsburgh, Pa.:

Lots of 1,000 lbs. and over.....$2.00 ℔
Lots of 500 lbs. and over..... 2.25 ℔
Lots of 100 lbs. and over..... 2.50 ℔

Metal guaranteed to be equal in quality to the best metal manufactured by any other process.

Prices on sheets, wire, tubes or castings given upon application.

"Star" Foot Lathe Swings 9x25 in.

Screw Cutting Automatic Cross Feed, etc.

LATHE

Scroll Saws, Circular Saws, Lathes Mortisers.

Catalogue Free of all our Machinery.

Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

GLEASON MACHINE TOOLS.

Engine Lathes 22 inch to 72 inch swing.
Iron Planers 26 inch to 84 inch wide.
Special Characteristics: Great weight, Great Power and Excellent Workmanship.

HILL, CLARKE & CO.,

156 OLIVER ST., BOSTON.

STANDARD OIL CUPS.

FOR HIGH SPEED ENGINES & MACHINERY. DYNAMOS.

A. J. WILKINSON & CO.,

184 Washington Street,

BOSTON, MASS.

DEPARTMENT OF THE INTERIOR.
WASHINGTON, March 13, 1890.

Sealed proposals for erecting an engine house and impounding reservoir, furnishing pumping engines and boilers, cast and wrought-iron piping, special castings, fittings, valves, lead, jute, and for erection and performing the work necessary to complete the pumping station on the Hot Springs Reservation, at Hot Springs, Ark., will be received at this Department until 12 o'clock M., Wednesday, April 30, 1890, when they will be opened. Blank forms of proposal, embracing specifications, together with drawings showing details, may be obtained upon application to the Department, or the Superintendent of the Reservation at Hot Springs, Ark. JOHN W. NOBLE, Secretary.

BABBITT METAL

Cooke & Co.'s Special Brands.

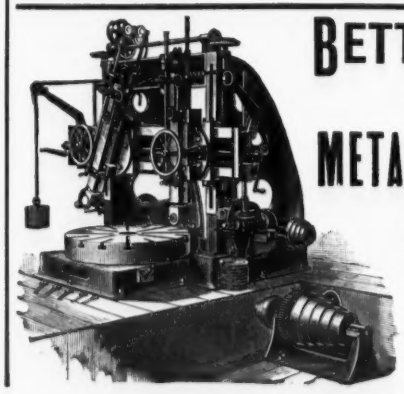
ACME, for high speeds and heavy work.

SUPERIOR, for jobbing and general use.

RELIABLE, for shafting bearings for ordinary service.

Write for prices or send us a sample order.

22 CORTLANDT ST., NEW YORK.



GEO. F. BLAKE MANF'G CO.

BUILDERS OF EVERY VARIETY OF

Pumping Machinery

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.

WATER WORKS PUMPING **ENGINES A SPECIALTY**

BETTS MACHINE COMPANY,

WILMINGTON, DEL.,

MAKERS OF

METAL-WORKING MACHINE TOOLS

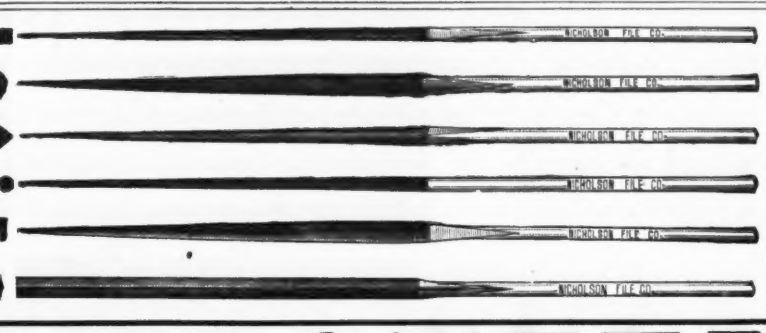
FOR

Locomotive, Bridge and Engine Builders, Railroad, Car and Machine Shops

AND

Iron and Steel Works Generally.

FILES and RASPS.



PROVIDENCE, R. I., U. S. A.

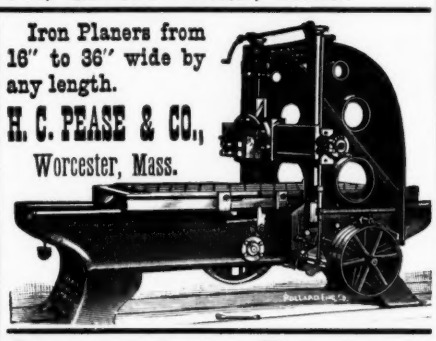
CRUCIBLE AND OPEN HEARTH
CAMERON SELF-HARDENING
STEEL
ESTABLISHED 1859.
HOWE, BROWN & CO., L't'd, Mfrs., Pittsburgh, Pa.
BRANCH OFFICES: 12 Cliff St., New York. 127 Oliver St., Boston. 228 Lake St., Chicago.

Established in 1874.
CLEVELAND TWIST DRILL CO.
Corner Lake & Kirtland Sts., Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.
FINE TAPS, DIES, REAMERS, ETC.

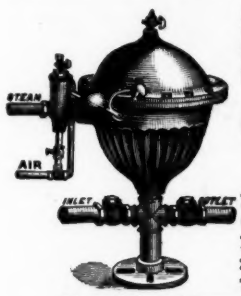
LIGHTNING AND GREEN RIVER SCREW PLATES.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS.

Maslin's Patent Pulsator Pump.
PAT. FEB. 12, 1889.
Cheapest and Best Automatic Steam Vacuum Pump. Handling DIRTY and GRITTY LIQUIDS without Wear, Oil or Care. Simple, Economical, Efficient & Durable. Pumping Plants for Contractors, Irrigation, Water Works, Railroads, Mining & General Hydraulic Purposes. Write or call for Circulars. JOHN MASLIN & SON, SOLE MANUF'RS. 165-167 1st St., Jersey City, N. J.

Iron Planers from 16" to 36" wide by any length.
H. C. PEASE & CO.,
Worcester, Mass.



CURTIS RETURN STEAM TRAP.



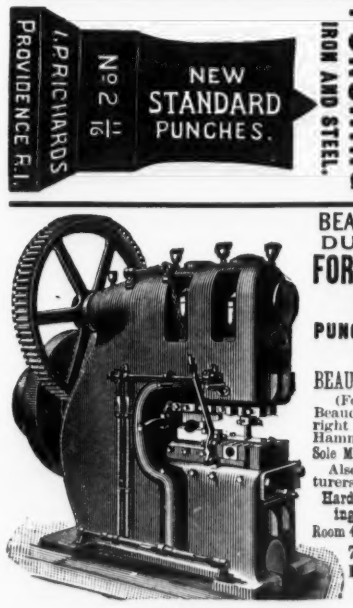
For returning steam, condensed under pressure, automatically into the boiler, under high or low pressure.
Manufactured by
CURTIS REGULATOR CO.,
Boston, Mass.
General Agencies:
109 Liberty St., N. Y.
66 N. 4th St., Phila., Pa.
108 5th Ave., Chicago, Ill.
210 S. 3d St., Minneapolis, Minn.
707 Market St., St. Louis, Mo.
Send for Circular No. 17.

Pease Iron Planers.
Following sizes carried in stock:
20 in., 22 in., 24 in., 26 in. & 30 in.
HILL, CLARKE & CO.,
156 OLIVER ST., - BOSTON, MASS.

P.H.&F.M.ROOTS,
Connersville, Indiana,
MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.

ROOTS' NEW ACME HAND-BLOWERS.
Slow-speeded, Force-blast. Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
S. S. TOWNSEND, Gen. Agt. } 22 CORTLANDT ST.,
COOKE & CO., Selling Agts. } NEW YORK.
In Writing, Please Mention This Paper.

ESTABLISHED 1842.
ROBERT POOLE & SON CO.
ENGINEERS AND MACHINISTS.
MACHINE MOULDED GEARING.
ALL KINDS OF TRANSMISSION MACHINERY OF THE HEAVIEST CLASS.
BALTIMORE, MD.

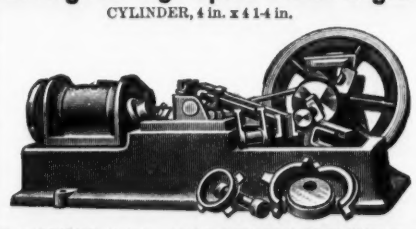


BEST SYSTEM on Earth for PUNCHING IRON AND STEEL.

VAN DUZEN'S
STEAM JET PUMP
For Water Supply Tanks.
For Fire Pump on Yard or Switch Engines.
For Round House General Work.
For Draining Ponds, Pits, Coffer Dams, etc.
10 Sizes. $7 to $75. Thousands in use.
Write for Descriptive Pump Circular, A.
VAN DUZEN & TIFT, CINCINNATI, O.

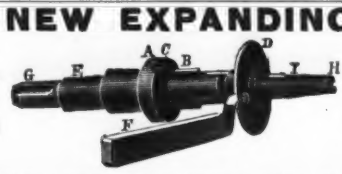
BEAUDRY'S DUPLEX FORGING PRESS, PUNCH AND SHEARS.
BEAUDRY & CO.
(Formerly of Beaudry's Upright Power Hammer.)
Sole Manufacturers.
Also Manufacturers of Hard Coal Heating Forges.
Room 4, Mason B'dg.
70 Kilby St., Boston, Mass.

Castings for High Speed Steam Engine.
CYLINDER, 4 in. x 4 1-4 in.



T. SHRIVER & CO., IRON AND BRASS FOUNDERS,
333 E. 56th St., N. Y. City.
Sets of Castings for Engine illustrated above, with *Cast-steel Shaft*, *Connecting Rod* and *Rock Shaft*, and *Brass Bearings*, boxed and delivered on boat or cars, in this city, on receipt of $38.00. This includes a *blue print* of working drawing

LECOUNT'S NEW EXPANDING MANDREL.
Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.



Machinist's Size.

No.		Price.
1	⅛ to 1 in.	$10
2	1 " 1½ "	14
3	1½ " 2 "	18
4 (with screws)	2 " 3 "	32
5 " "	3 " 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.

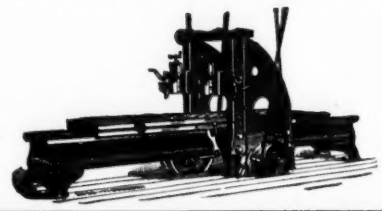
HALL DUPLEX STEAM PUMPS.
Send for 1890 Catalogue.

Fire Pump.

HALL STEAM PUMP CO.,
91 LIBERTY ST., NEW YORK.
PITTSBURGH. CHICAGO. ST. LOUIS.

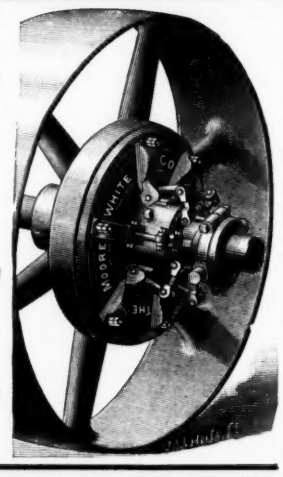
Boiler and Pump Combined.

FITCHBURG MACHINE WORKS.
Manufacturers of
METAL-WORKING MACHINES.
Office and Works,
13 to 21 Main Street,
FITCHBURG, MASS.
Send for Catalogue (E.)



THE CHESTER FOUNDRY & MACHINE CO.,
CHESTER, PA.
Builders of CRANES of every type and capacity, MARINE, PUMPING and BLOWING ENGINES, CORLISS ENGINES, HYDRAULIC PRESSES, ACCUMULATORS, and SPECIAL MACHINERY of every description. CASTINGS IN DRY OR GREEN SAND AND LOAM.

THE MOORE & WHITE CO.,
Philadelphia, Pa.
Friction Clutch Pulleys, Cut-off Couplings, &c.

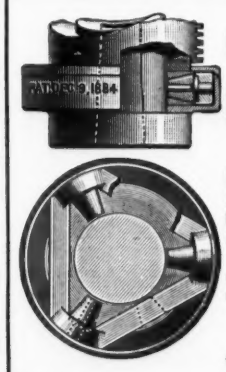


PECK'S PAT. DROP PRESS.
NEW HAVEN
BEECHER & PECK, CONN.
DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.

WILLIAM JESSOP & SONS, L'D.
MANUFACTORY, SHEFFIELD, ENGLAND.
Chief American Office, 91 JOHN ST., NEW YORK.
JESSOP'S BEST TOOL STEEL
Gold Medal, Paris, 1889.
ALL KINDS OF Steel in Stock.
Importation Orders Promptly Filled.

MACHINE TOOLS
ENGINE LATHES,
BRASS LATHES,
BORING AND TURNING MILLS,
SCREW MACHINES,
on hand and in process of construction.
BRIDGEPORT MACHINE TOOL WORKS,
E. P. BULLARD, PROPRIETOR.
BRIDGEPORT, CONN.

EMPLOYERS' LIABILITY ASSURANCE Corporation Limited
London, Eng.
Deposited in the U. S., $670,000.00.
Trustees for the United States.
OLIVER W. PEABODY, Esq., Kidder, Peabody & Co., Boston.
CHAUNCEY M. DEPEW, Esq., Pres. N. Y. C. & H. R. R. R. Co., New York.
SAMUEL SLOAN, Esq., Pres. D., L. & W. R. R. Co., New York.
WM. A. FRENCH, Esq., Pres. Mass. Nat'l Bank. Abram French & Co., Boston.
HON. JOHN LOWELL, Boston.
Chief Office in United States, 71 Kilby St, Boston, Mass.
ENDICOTT & MACOMBER, Managers & Attorneys.
AGENTS IN ALL CITIES.



THE BROWNELL ANTI-FRICTION Step or Thrust Bearing
FOR
Lathes, Drills, Worm Shafts of Elevators or Hoists, Jack Screws, Mill Stones, Water Wheel and Propeller Shafts.
Bearings of all sizes made to order, and patent rights for sale by
G. L. BROWNELL,
WORCESTER, MASS.
Correspondence Solicited.

WORTHINGTON—HIGH DUTY—Pumping Engine
—FOR—
WATER WORKS
OVER 100,000,000 DUTY
—GUARANTEED—
SEND FOR RECENTLY ISSUED PAMPHLET
HENRY R. WORTHINGTON
NEW YORK CITY.

SUGGESTIVE FACTS FOR STEAM USERS.

BEMENT, MILES & CO., PHILADELPHIA.

After the fullest investigation, have just ordered a battery of 402 H. P. of Harrison Safety Boilers for the large addition now being built to their extensive works.

Pamphlet describing and illustrating the type of boiler they selected mailed upon application to

HARRISON SAFETY BOILER WORKS,

Germantown Junction, Philadelphia, Pa.

NEW YORK, N. Y. 41 Dey Street. | CHICAGO, ILL. 6 So. Canal Street. | ATLANTA, GA. 9 No. Pryor Street. | MINNEAPOLIS, MINN. 707 Lumber Exchange.

POND ENGINEERING CO.,

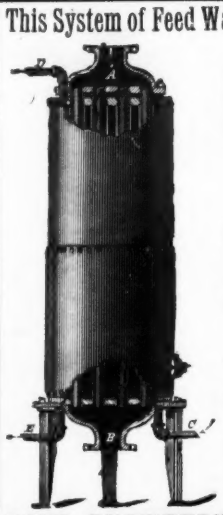
CONTRACTING ENGINEERS,

Engines, Boilers, Pumping Engines, Feed Pumps, Feed-water Heaters and Purifiers, Injectors, &c.

Send for ILLUSTRATED CIRCULAR.

St. Louis. Chicago. Kansas City. Omaha.

This System of Feed Water Heater is the Best



AND THE

LOWE

is the simplest

HEATER

on the System.

Has Straight Tubes

With reliable provision for expansion, and will

HEAT AND PURIFY THE WATER

EQUAL TO ANY

With same Feet of Heating Surface and

Wear the Longest.

Send for description and Histories of Boilers and Feed Water Heaters to

Bridgeport Boiler Works

Bridgeport, Conn.

POND ENGINEERING CO., AGENTS,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA.

THOS. H. DALLETT & CO.

1305 Buttonwood Street,

PHILADELPHIA, PA.

Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses, Special Machinery.

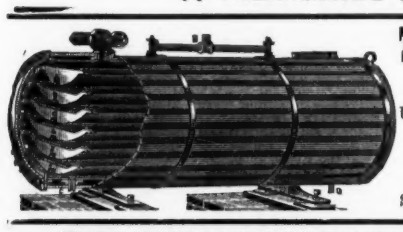
SEND FOR CATALOGUE.

THE STERLING WATER TUBE BOILERS

Have unusually large steam and water spaces and well-defined circulation. The fire-brick furnace and almost vertical water tubes give remarkable economy of fuel with rapid and steady steaming. Dry steam at any pressure. Large mud-drum. First cost moderate. Freedom from leakage and repairs. No cast metal. No hand-holes. Three man-holes give quick access to every part of the boiler.

THE INTERNATIONAL BOILER CO., Ltd.,

74 CORTLANDT STREET, NEW YORK.



The HOPPES Live-Steam Feed-Water Purifier,

Guaranteed to Prevent Scale in Boilers.

Using any kind of water. Hard Sheet Steel Troughs, *Easily Cleaned.*

HOPPES MANUFACTURING CO.,

Send for Catalogue D. SPRINGFIELD, OHIO.

WM. BERKEFELD'S FOSSIL MEAL COMPOSITION.

The best non-conducting material known for Steam Pipes and Boilers. Can be easily removed and repeatedly reapplied.

ITS PLASTIC NATURE INSURES AN ABSOLUTELY TIGHT JOINT.

Requires less thickness than any other covering.

Trade-mark. W. B. C.

FOSSIL MEAL CO., 2 Cedar St., N. Y.

PATENT OILERS, CYLINDER SIGHT FEED CUPS.

Government Regulation

POP SAFETY VALVES,

For Stationary, Marine and Locomotive Boilers.

J. E. LONERGAN & CO., BRASS FOUNDERS AND FINISHERS,

211 Race Street, Philadelphia, Pa.

1888 CATALOGUE FREE ON APPLICATION.

All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS.

"Phosphor-Bronze."

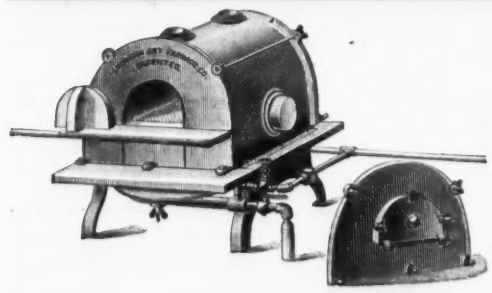
PHOSPHOR-BRONZE

INGOTS, CASTINGS & MANUFACTURES.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED

512 ARCH ST. PHILADELPHIA PA. U.S.A.

ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.



American Gas Furnace Co.,

Designers and Manufacturers

GAS BLAST FURNACES.

Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**

No. 80 NASSAU STREET,

NEW YORK.

GRAPHITE PAINT

FOR SMOKE STACKS, ROOFS AND IRON WORK.

COVERS TWICE THE SURFACE, DEFIES HEAT AND COLD,

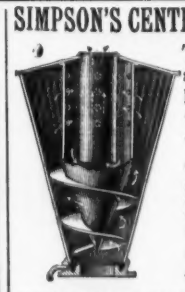
AND LASTS 5 TO 10 TIMES AS LONG AS ANY OTHER PAINT.

SEND FOR DESCRIPTIVE CIRCULAR.

JOS. DIXON CRUCIBLE CO.,

JERSEY CITY, N. J.

SIMPSON'S CENTRIFUGAL EXHAUST HEAD.



Thoroughly entraps water and grease from the exhaust of a steam engine without back pressure, preventing them from spraying on the sidewalks and roofs of buildings; it protects the latter from injury, and passers by from annoyance and damage. Send for circular to

KEYSTONE ENGINE & MACHINE WKS.,

5th and Buttonwood Sts., Phila., Pa.,

Or A. T. ARTHUR, Selling Agent, 18 Cortlandt Street, N. Y.

WESTCOTT CHUCK CO., Formerly Oneida Steam Engine & Foundry Co., ONEIDA, N. Y.

Manufacturers of all kinds of

LATHE AND DRILL

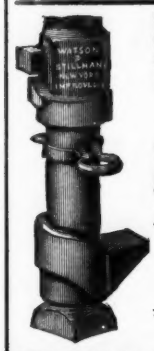
CHUCKS.

Send for Catalogue.

Under Westcott's Patent.

Capacity Little Giant Improved.

No.	Diameter.	Holding Drills.
00	1¼ inch.	0 to ¼ inch.
0	2¼ "	0 to ½ "
1	2¾ "	0 to ⅝ "
2	3½ "	0 to 1 "
2½	4 "	0 to 1 in., ex. strong.
3	6 "	0 to 1¼ inch.
4	6½ "	0 to 2 "



HYDROSTATIC MACHINERY,

PRESSES, PUMPS, PUNCHES,

ACCUMULATORS,

JACKS, VALVES, FITTINGS, &c., &c.

WATSON & STILLMAN,

204-210 E. 43D ST., NEW YORK.

VOLNEY W. MASON & CO.,

Friction Pulleys, Clutches and Elevators,

PROVIDENCE, R. I.

"THE HORTON LATHE CHUCK"

has sustained the tests and been the STANDARD for FORTY YEARS.

Over THREE HUNDRED sizes and styles of Chucks, made and kept in stock, by

THE E. HORTON & SON CO.,

WINDSOR LOCKS, CONN., U. S. A.

SEND FOR ILLUSTRATED PRICE LIST.

PATENT 4 JAW LATHE CHUCK

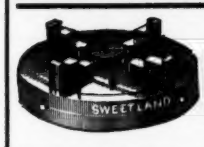
THIS CAN BE USED AS A UNIVERSAL INDEPENDENT OR ECCENTRIC CHUCK WITH BETTER SATISFACTION THAN MANY OF THE COMBINATION CHUCKS NOW IN THE MARKET

SOLD BY ALL DEALERS

13 SIZES FROM 8 INCH TO 26 INCH INCLUSIVE

MANUFACTURED BY THE CUSHMAN CHUCK CO. HARTFORD, CONN.

SEND FOR NEW DESCRIPTIVE CATALOGUE OF CHUCKS



"SWEETLAND" CHUCKS

SEND FOR DISCOUNTS.

THE HOGGSON & PETTIS MFG. CO.,

Est. 1849. NEW HAVEN, CONN.

PEQUOT DRILL CHUCK.

A new Drill Chuck having a more powerful grip than any chuck ever offered. This seems a broad claim, but we prove it to mechanics who will examine. Ask at your dealers or write us for particulars.

THE D. E. WHITON MACHINE CO.

NEW LONDON, CONN.

S. A. SMITH, 23 S. Canal St., Chicago, Western Agt.

L. S. STARRETT,

Manufacturer of

FINE TOOLS,

ATHOL, MASS.

SEND STAMP FOR FULL LIST.

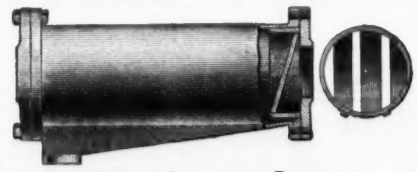
BARNARD'S SEPARATOR

For Separating and Removing Entrained Water from Live Steam;

AND

Condense Water, Oil, Dirt, Etc., from Exhaust Steam.

SPECIAL DESIGNS FOR SURFACE CONDENSERS.



SEND FOR CIRCULAR AND PRICES.

GEO. A. BARNARD,

15 CORTLANDT ST., NEW YORK.

CHARLES MURRAY

ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

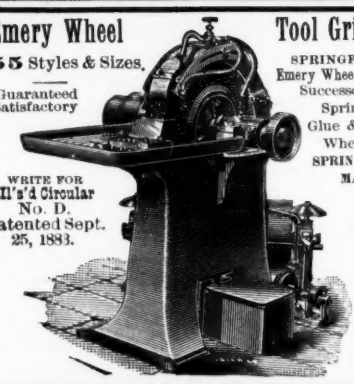
Emery Wheel Tool Grinder.

55 Styles & Sizes.

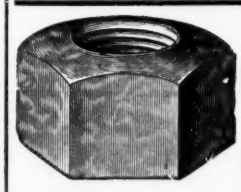
Guaranteed Satisfactory

SPRINGFIELD Emery Wheel Mfg. Co. Successors to Springfield Glue & Emery Wheel Co., SPRINGFIELD, MASS.

WRITE FOR Il's'd Circular No. D. Patented Sept. 25, 1883.



Water Prevents HEATING THE WORK.



FINISHED

HEXAGON NUTS.

Accurate to Gauge.

Orders Promptly Filled.

TRUMP BROS. M'CH CO.,

Wilmington, Delaware.

CLASS "A."

This style is made from 1-2 in. to 1 1-2 in. No wrench required. Can't slip. Satisfaction guaranteed. Write for Catalogue showing the different styles.

MANUFACTURED BY

THE MIDDLETOWN (OHIO) MACHINE CO.

MACHINERY For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.

For Machines or Information, address the Manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

SPRUE CUTTERS. SHEARS. TOGGLE-JOINT DRAWING PRESSES.

STILL IN THE LEAD!

THE ONLY AMERICAN FIRM

AWARDED

A GOLD MEDAL AT THE PARIS EXPOSITION 1889.

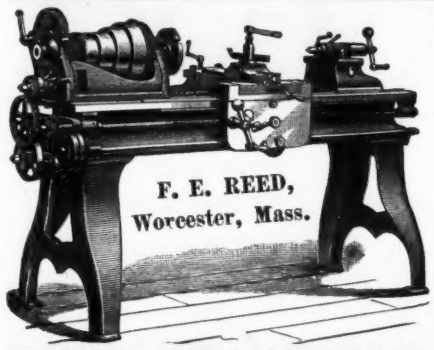
FOR SUPERIORITY IN PRESSES, DROP HAMMERS AND DIES.

THE STILES & PARKER PRESS CO.,

203-207 Centre Street, NEW YORK. MIDDLETOWN, CONN.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.
Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

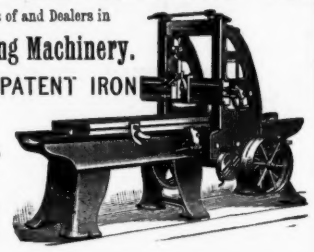
Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

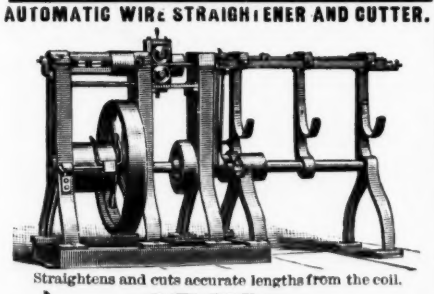
FLATHER ENGINE LATHES
14, 15, 16, 18, 20, 24 and 28 INCH SWING.
ANY LENGTH OF BED UP TO 22 FEET.
HILL, CLARKE & CO.,
General Selling Agents,
156 OLIVER ST., BOSTON, MASS.

L. W. POND MACHINE CO.
Manufacturers of and Dealers in
Iron Working Machinery.
IMPROVED PATENT IRON PLANERS A SPECIALTY.
152 Union St., WORCESTER, MASS.

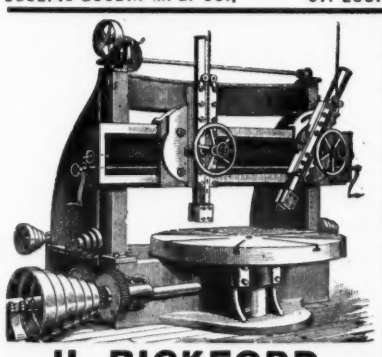


FLATHER IRON PLANERS.
Beautiful Designs. Accurate Workmanship.
22, 24, 26 and 30 Inch.
HILL, CLARKE & CO.,
General Selling Agents,
156 OLIVER ST., BOSTON, MASS.

AUTOMATIC WIRE STRAIGHTENER AND CUTTER.



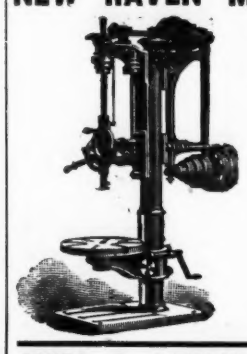
Straightens and cuts accurate lengths from the coil.
—MANUFACTURED BY—
COLLINS-GOODIN MFG. CO., - ST. LOUIS, MO



BORING AND TURNING MILLS, 4, 5 and 6 Ft. SWING.
H. BICKFORD,
LAKE VILLAGE, N. H.

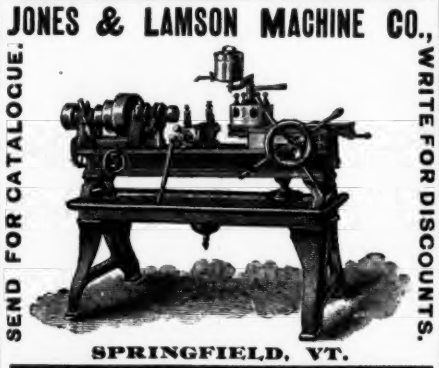
MACHINISTS' FINE TOOLS.
STANDARD TOOL CO., ATHOL, MASS.
Catalogue and Price List free

NEW HAVEN MANUF'G CO.,
New Haven, Conn.

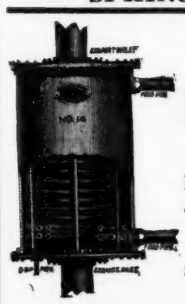


Lathes,
Planers,
Shapers,
Slotters,
Etc.

JONES & LAMSON MACHINE CO.,

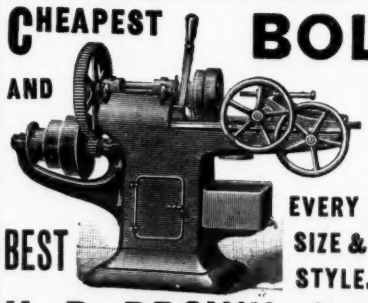


SEND FOR CATALOGUE. WRITE FOR DISCOUNTS.
SPRINGFIELD, VT.



THE NATIONAL Feed-Water HEATER.
A brass coil Heater delivering water to the boiler at 210° Fahrenheit.
300,000 Horse Power sold. Prices Low. Satisfaction universal.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN

CHEAPEST AND BEST BOLT CUTTERS.



EVERY SIZE & STYLE.
H. B. BROWN & CO.,
EAST HAMPTON, CT.

Send 36 cents for a Sample Bottle of the *Best Drawing Ink ever made*—
HIGGINS' AMERICAN
—or Stamp for a 200 Page Catalogue of all Drawing Instruments and materials.
G. S. WOOLMAN,
116 FULTON ST., NEW YORK.

WELDLESS STEEL QUICK OPENING GATE VALVE COLD DRAWN TUBES
SMOOTH INSIDE & OUT.
JOHN S. LENG, 4 Fletcher St. N.Y.

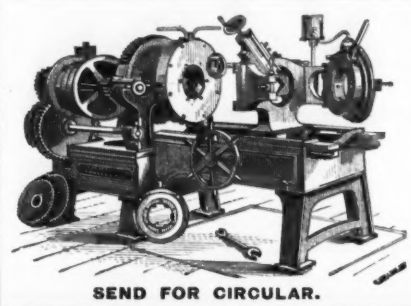
A NEW JAW
about once a year will make this Cutter last until you forget when you bought it, as the body never wears out.
Warranted to Cut Straight.

THE "EUREKA" PIPE CUTTER
IS THE BEST AND CHEAPEST MADE.

No. 1 Cuts	⅛ to 1 inch Pipe	$1.00	Nos. 1 and 3 will cut all sizes from ⅛ to 3 inch
No. 2 "	¼ to 2 " "	1.50	
No. 3 "	1 to 2 " "	4.65	

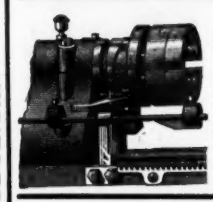
Any Jobber can furnish this tool to you at these prices.
PANCOAST & MAULE,
243 and 245 South Third Street, Philadelphia.

CARY & MOEN CO. STEEL WIRE OF EVERY DESCRIPTION & STEEL SPRINGS. NEW YORK
W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

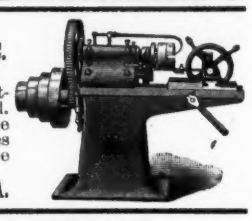


D. SAUNDERS' SONS,
Manufacturers of
Pipe Cutting & Threading Machines
For Pipe, Mill and Steam Fitters' Use.
TAPPING MACHINES,
For Steam Fitting, also
Steam and Gas Fitters' Hand Tools.
SEND FOR CIRCULAR. YONKERS, N. Y.

BUFFALO FORGES
BLOWERS, EXHAUSTERS, HEATING FURNACES. HAND BLOWERS, BLACKSMITH DRILLS.
BUFFALO FORGE CO. BUFFALO, N.Y.



ADAMS
Automatic Bolt-Threading & Nut Tapping Machine.
Made in all Sizes to Cut from 1-4" to 6".
The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to
Capitol Mfg. Co., Rees St. near Halsted, Chicago, Ill., U. S. A.



NO MACHINE SHOP CAN AFFORD TO BE WITHOUT
NICHOLSON'S EXPANDING MANDRELS.
Write for new Price List. W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

SAVE YOUR MONEY BY USING RIDER'S "Victor" Lathe and Planer Tool.

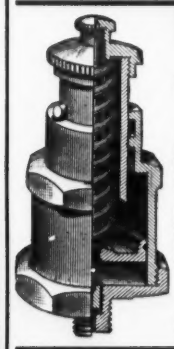
Cutters made direct from bar of Round Steel. *No fitting* required. Send Square or for prices.
FRANK L. B. RIDER, South Newmarket, N. H.

BARNES' PATENT FOOT POWER MACHINERY.
WORKERS OF WOOD OR METAL,
without steam power, by using outfits of these Machines, can bid lower, and save more money from their jobs, than by any other means for doing their work. Also for
Industrial Schools or Home Training.
With them boys can acquire practical journeymen's trades before they "go for themselves." Price List Catalogue Free.
W. F. & JOHN BARNES CO., No. 1995 Ruby St., Rockford, Ill.

OUR NEW CATALOGUE OF TOOLS
And Supplies sent free to any address on receipt of Ten Cents in Stamps (for postage).
Chas. A. Strelinger & Co., WOOD AVE. Detroit, Mich.

PATENTS.
During **March, April** and **May** my fees due only on allowance if desired. Write
WM. H. BABCOCK,
513 Seventh St., Washington, D. C., P. O. Box 220.
Formerly Examiner in Patent Office.
FOURTEEN YEARS' PRACTICE.

BLAISDELL ENGINE LATHES.
Great Variety of Styles and Sizes on Hand.
AND ALSO
NEW PATTERN UPRIGHT DRILLS.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.



LACKAWANNA GREASE CUP
Will Save Its Cost in Oil alone Several Times per Annum.
SAVES ALSO IN LABOR, AND COST OF COTTON-WASTE. PREVENTS DRIPPING AND SPATTERING.
A POSITIVE FORCE FEED with the most PERFECT REGULATION and GREATEST CONVENIENCE in operation yet attained in any device for the lubrication of machinery. Works equally well in every possible position.
Lackawanna Lubricating Co.,
41 Coal Exchange, Scranton, Pa.

WILLIAM BARKER & CO.,
Manufacturers of
Iron and Brass Working
MACHINERY,
140 & 142 E. SIXTH ST.,
Near Culvert,
CINCINNATI, O.
Send for Circulars and Prices.

CURTIS & CURTIS,
66 Garden St., Bridgeport, Ct., U.S.A.
MANUFACTURERS OF
The Forbes Pat. Die Stock,
IMPROVED AND PERFECTED.
Pipe Cutting and Theading Machine, etc.
A portable cutting and threading machine with which one man can with ease thread pipe up to six inch diam. No vise is required.
SEND FOR ILLUSTRATED CATALOGUE.
Ratchet Drills, Ratchet Die Stocks and Malleable Iron Pipe Vises.

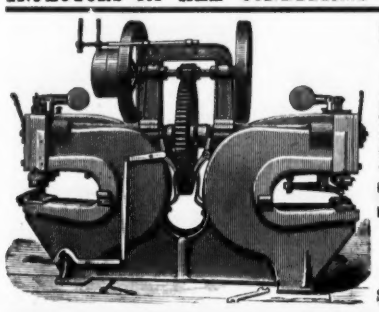
BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines, Drilling Machines, Bolt Cutting Machines.
Send for Catalogue.

A NEW INVENTION.
SURE GRIP STEEL TACKLE BLOCK.
HALF THE COST of hoisting saved to Machinists, Contractors, Butchers, Builders and others. Admitted to be the greatest improvement EVER made in Tackle Blocks. The cheapest in the market. *Write for Catalogue.*
FULTON IRON & ENGINE WORKS,
29 BRUSH STREET,
Established 1852. DETROIT, MICH.

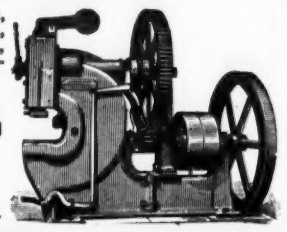
FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS
JAS. HUNTER & SON,
North Adams, Mass.

DAMPER REGULATORS.
Our Steam Damper Regulator is the most perfect and simplest machine in the market. Price, $60 and $100. Any one can apply it. Send for circular to Mason Regulator Co., Boston.

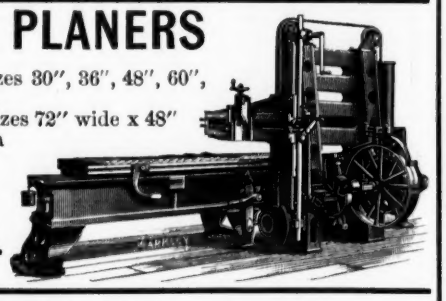
WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL,
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE



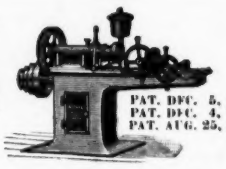
THE LONG & ALLSTATTER CO. Hamilton OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.



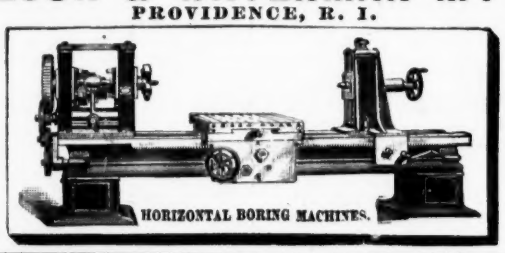
THE OPEN-SIDE IRON PLANERS
STANDARD OPEN-SIDE PLANER, Sizes 30″, 36″, 48″, 60″, by any desired length.
OPEN-SIDE EXTENSION PLANERS, Sizes 72″ wide x 48″ high x 10′ long, up to 120″ wide x 72″ high x 20′ long.
Open-Side Frog and Switch Planers.
Extra Heavy and Powerfully Geared Up.
The DETRICK & HARVEY MACHINE CO.
BALTIMORE, MD.



ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of
ACME BOLT & RIVET HEADERS,
Acme Single & Double Automatic BOLTCUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM, CINCINNATI CENTENNIAL.

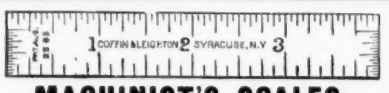


NICHOLSON & WATERMAN M'F'G CO.,
PROVIDENCE, R. I.
LATHES.
CUTTING-OFF MACHINES,
TRAVERSE DRILLS,
TRAVERSE BORING MACHINES,
SPECIALS,
&c., &c.

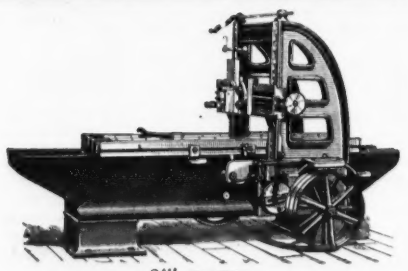


BOLT & NUT MACHINERY.
BROACHING MACHINES.
FACING MACHINES.
BOLT LATHES,
STAY BOLT THREADERS,
&c., &c.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.
WORCESTER, MASS.
Manufacturers of Set, Cap & Machine Screws, Studs, etc.



MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

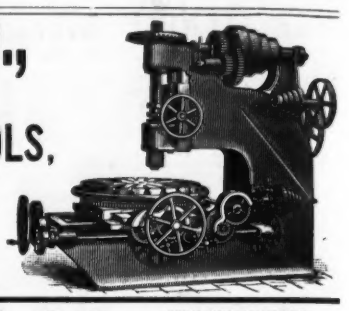


24″ PLANER.
IMPROVED 24 INCH IRON PLANER.
Note the following features.
Extra deep beds.
Extra heavy housings.
Extra wide gearing.
Extra deep tables.
Extra heavy Cabinet legs.
Planers reversed from both sides.
All feeds handled from both sides.
Sleeves for bearings driven entire length solidly into bed.
Special device for holding planer bolts.
32″ and 36″ Planers in process of construction.
Write for price with cuts and descriptions.
— THE —
LODGE & DAVIS MACHINE TOOL CO.,
WORKS, CINCINNATI, O.
EASTERN HOUSE:
64 CORTLANDT STREET,
NEW YORK.
WESTERN HOUSE:
68 & 70 SOUTH CANAL ST.,
CHICAGO.
See advertisements, pages 15 and 16.

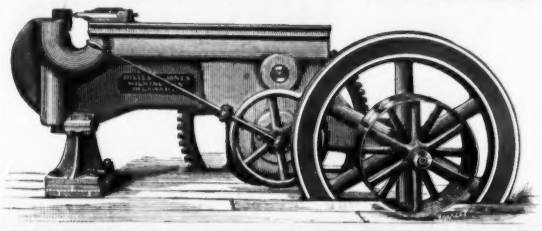
J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY
Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.
W. H. DOANE, Pres. D. L. LYON, Sec'y.

Bolt and Nut Machinery.
12 Sizes of National Bolt Cutters.
6 Sizes and Styles of Rapid Bolt Cutters.
5 Sizes and Styles of Bolt Pointers.
15 Sizes and Styles of Bolt Headers.
12 Sizes and Styles of Nut Machines.
14 Sizes and Styles of Tappers.
3 Sizes and Styles of Washer Machines.
3 Sizes and Styles of Spike Machines.
2 Sizes of Car Link Machines.
3 Sizes of Car Pin Machines.
7 Sizes and Styles of Wire Nail Machines.
5 Sizes and Styles of Bulldozers.
Also large variety of Tools in this line, making complete outfits for Bolt Shops. Catalogue sent on application. Apply to
THE NATIONAL MACHINERY CO.,
TIFFIN, OHIO.

BEMENT, MILES & CO.,
PHILADELPHIA, PA.,
BUILDERS OF
METAL-WORKING MACHINE TOOLS,
FOR
RAILROAD SHOPS,
LOCOMOTIVE AND CAR BUILDERS,
MACHINE SHOPS, ROLLING MILLS,
STEAM FORGES, SHIP YARDS,
BOILER SHOPS, BRIDGE WORKS, ETC.

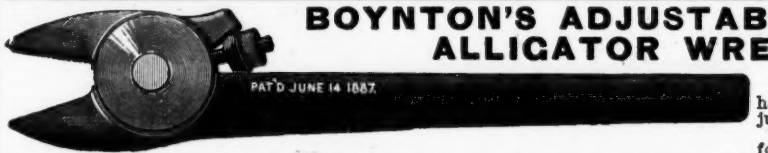


The HILLES & JONES CO., WILMINGTON, DELAWARE,
MANUFACTURERS OF
MACHINE TOOLS,
FOR
BOILER MAKERS, BRIDGE BUILDERS, SHIP BUILDERS, RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, ETC., ETC.
HORIZONTAL FLANGE PUNCHES, ALL SIZES.



THE AERATED FUEL COMPANY,
425 MAIN STREET, SPRINGFIELD, MASS. J. H. BULLARD, MANAGER.
FORGING AND WELDING BY PETROLEUM AIR BLAST.
ALL OIL BELOW BURNERS! NO SMOKE, DIRT, OR ASHES!
Represented by WILLIAM PICKETT, SON & CO., 170 Lake St., Chicago; W. S. COLLINS, 171 Broadway, New York. CHILION JONES, Gananoque, Can. G. M. SMITH, Los Angeles, Cal. KALAMAZOO SPRING AND AXLE CO., Kalamazoo, Mich. C. S. BARROWS, 46 Wade Building, Cleveland, Ohio. GILBERT & BARKER MFG. CO., General Agents for the United States, Springfield, New York and Boston.
Sept. 29, 1885. July 5, 1887. Feb. 5, 1889. July 23, 1889.
We will replace in Stock or Mutual Companies any Insurance canceled on account of using this System, when installed according to our plans.

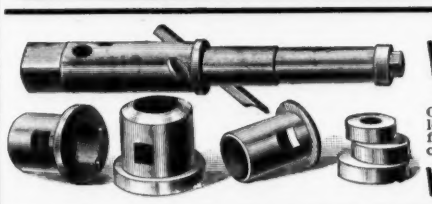
BOYNTON'S ADJUSTABLE ALLIGATOR WRENCH.



Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. Six sizes.
CAMPBELL PRINTING PRESS AND MFG. CO., MFRS.
160 WILLIAM ST., NEW YORK. 325 DEARBORN ST., CHICAGO.

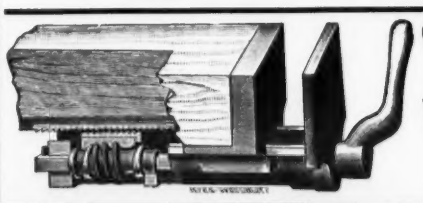
Our Location, Foundry Capacity and Machine and Pattern Shop Equipment afford us **special facilities for furnishing HEAVY CASTINGS TO ORDER,** in any quantity up to size 20,000 lbs, or **SMALL CASTINGS** where large quantities are required. Get our estimates and prices before ordering.
ALLENTOWN FOUNDRY & MACHINE CO.,
3d and Walnut Streets, ALLENTOWN, PA.

— THE —
Vance Lightning Flue Cutter



For removing Flues from Locomotive and Stationary Boilers. One man can cut five hundred (one end) in a day. In use in the leading Railroad Shops of the country. Combination Cutter for removing 2 in., 2 1-4 in., 2 1-2 in. and 3 in. Flues, $50. Sent on approval to Railroad Co's. Liberal Discounts to the Trade.
VANCE TUBE CUTTER CO., Geneva, N. Y.

QUICK-ACTION VISES,
For Pattern Makers and Wood Workers.



WYMAN & GORDON,
WORCESTER, MASS.
DROP FORGINGS.

LATHE
FOR
TOOL MAKING, MODEL MAKING.

Waltham, Mass.
SCREW CUTTING, GRINDING AND EXTRA FINE WORK.
SEND FOR BOOK OF DESCRIPTION.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
Machinist,
Successor to
BREHMER BROS.,
440 N. 12th St., Philadelphia, Pa.

BALL AUTOMATIC CUT-OFF ENGINES,
ERIE, PA.
The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.
CHARLES R. VINCENT & CO.,
NEW YORK SELLING OFFICE, 15 CORTLANDT STREET.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 2,500.

25 to 1,000 H. P.

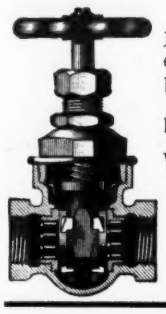
These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: W. L. SIMPSON, 10 TELEPHONE BUILDING, } N. W. ROBINSON, 154 Washington St., Chicago, Ills.
18 CORTLANDT STREET, N. Y. } ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

BLESSING'S RENEWABLE-SEAT GLOBE, STRAIGHTWAY and CHECK VALVES.



The Renewable-Seats and Disks are cast from the best Phosphor Bronze Metal, which has lasting qualities, double that of the best Steam Metal commonly used in first-class valves. The seats are simply screwed to place by the use of a special wrench furnished with each valve.

These valves are equally applicable to steam, water, or other fluid pressure.

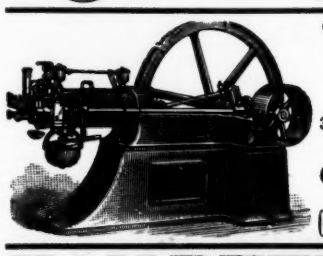
We also manufacture **Blessing's Albany Steam Traps, Water Circulator and Purifier; and Pump Governor.**

SEND FOR CIRCULAR.

ALBANY STEAM TRAP CO.,

ALBANY, N. Y.

"OTTO" GAS ENGINE WORKS.



SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts., PHILADELPHIA. Branch Office, 151 Monroe St., CHICAGO.

OVER 25,000 ENGINES IN USE.

GUARANTEED To consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work

VAN DUZEN GAS & GASOLINE ENGINE

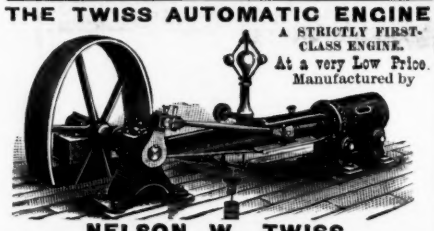
OPERATED with COAL and OTHER MANUFACTURED GASES AND GASOLINE.

RELIABLE AND ECONOMICAL.

Fully Warranted

VAN DUZEN Gas & Gasoline Engine Co.
50 E. 2d St., Cincinnati, O.

THE TWISS AUTOMATIC ENGINE

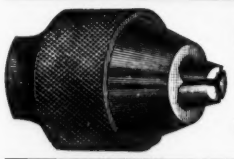


A STRICTLY FIRST-CLASS ENGINE.
At a very Low Price.
Manufactured by

NELSON W. TWISS,
25 Whitney Ave., New Haven, Conn.
Send for Price before Purchasing Elsewhere.

ALSO VERTICAL AND YACHT ENGINES.

PATENT UNIVERSAL DEPTH ANGLE AND SCREW-CUTTING CENTER **TWIST DRILL GAUGE.**
J. WYKE & CO., Fine Machinists' Tools.—5. Boston, Mass.—Send for Circular.



Almond Drill Chuck
Sold at all Machinists Supply Stores.
T. R. ALMOND,
83 & 85 Washington St
BROOKLYN, N. Y

MACHINERY ON HAND.

9-in. Crank Shaper, H. & P. Good order.
12, 15, 22 and 15-in. Crank Shaper, Juengst. New.
24 in. Bridgeport Shaper, 2d hand. A 1.
24-in. Shaper, Bridgeport. New.
12-in. stroke Trav. Head Shaper. New.
22 in. x 5 ft. Planer, Wheeler. New.
24 in. x 6 ft. " Powell. New.
26 in. x 8 ft. " Pond. Good
7 and 11 in. swing Hand Lathes. New
11 x 5 ft. and 14 x 6 ft. Engine Lathes, Prentiss.
16 x 8 ft. " " "
14, 16 and 18 in. " " Blaisdell.
14 and 16 in. x 6 and 7 ft. " " Bogert.
16 in. x 6 and 8 ft. Engine Lathe, McMahon. New.
18 in. x 8 and 10 ft. " " "
20 in. x 8, 10 and 12 ft. Engine Lathe, McMahon.
20 and 24 in. Engine Lathe, Bridgeport.
20 in. x 8 ft. " " W., L & Co. Good.
20 in. x 14 ft. " " Wright. New.
28 in. x 14 ft. " " F. & S. New.
32 in. x 16 ft. " " F. & S. New.
16 in. x 10 ft. Islin Eng. Lathe. Good.
26 in. x 50 in. Pulley Lathe, Stevens. Good.
36 in. Stephens Pulley Lathe. New.
No. 1 and 2 Slate Sensitive Drill. New.
2, 3 and 4 Spindle Drills, Slate. New.
20, 22, 23, 25, 28 and 32 in. Drills. New.
Ames Index Milling Machine. Fair.
No. 3 National Bolt Cutter. New.
No. 3 Brown & Sharpe Universal Miller, with set of Tools, lot of Cutters, &c., Good as new.
1 No. 37 E. W. Bliss Co. Power Press, A 1 order.
I. X. L. Saunders Pipe Machine. A1 order.

Cold Rolled Shafting in stock, all sizes.

Full line of new Machinery. Write for what you want.

Send for our list of new and second hand tools for sale.

E. P. BULLARD,

72 Warren St., and 62 College Place, New York.

SPECIAL SALE

Of the following first-class **MACHINE TOOLS** of modern style, complete and in perfect order, which we have replaced with larger tools.

Brown & Sharpe No. 5 Screw Machine, 1⅜ hole, Chasing bar and feed on turret.
Brown & Sharpe No. 3 Screw Machine, ¾ hole, with Chasing bar.
Jones & Lamson No. 2 Screw Machine, ¼ hole, with feed on turret.
Niles Pulley Lathe with 2 heads.

ALSO

3 Jib Cranes of most improved form, 5 tons capacity for sale very low.

Send for our complete list of new and second-hand Machinery.

J. J. McCABE,

68 Cortlandt Street, NEW YORK.

⅜" **FLEXIBLE METALLIC FILLET**
For Pattern Makers' Use.
H. WHITE, 44 N. 4th Street, Phila., Pa.

BRAINARD MILLING MACHINES,

25 Different Styles and Sizes.

HILL, CLARKE & CO.,

General Selling Agents,

156 OLIVER ST., BOSTON, MASS.

NEW AND IMPROVED MILLING MACHINE.

☞ Note the following new features:
☞ Overhanging arm removed without taking off the sleeve.
☞ Sleeve for the overhanging arm and the column cast in one piece.
☞ All movements operated from front of machine instead of under the table.
☞ Long bearings. Long and wide tables.
☞ Power feed entire length of table.
☞ Large spindles, hollow their entire length.
☞ Indexed feeds on all machines.
☞ Large cones, wide belts.
☞ Each machine furnished with a vise.
☞ Built either plain, back geared or universal.
☞ Write for prices, with cuts and full descriptions.

—THE—

LODGE & DAVIS MACHINE TOOL CO.,

CINCINNATI, OHIO.

EASTERN HOUSE:

64 CORTLANDT STREET,

NEW YORK

WESTERN HOUSE:

68 & 70 SOUTH CANAL ST.,

CHICAGO

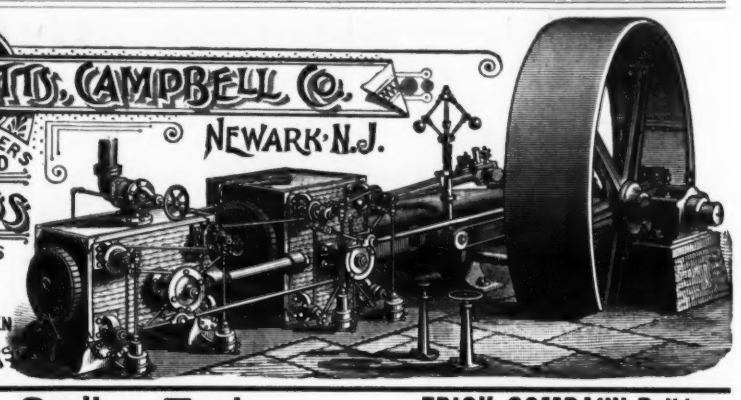
See advertisement, page 16.

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N. J.

CONTRACTS TAKEN FOR COMPLETE POWER PLANTS



Eclipse Corliss Engine.

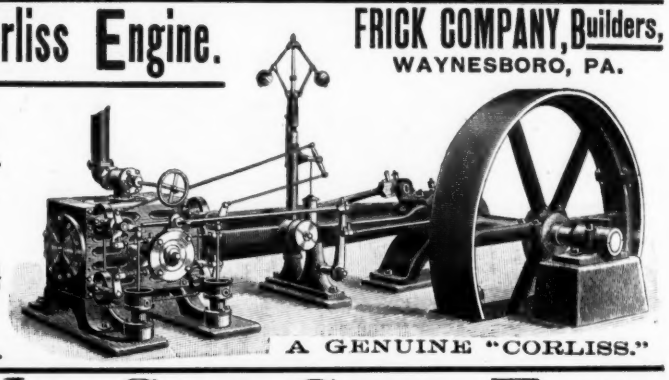
FRICK COMPANY, Builders,
WAYNESBORO, PA.

NON-CONDENSING,
CONDENSING COMPOUND.
40 TO 1,000 H.P.

Send for Circulars.

ICE-MAKING AND REFRIGERATING MACHINERY.

Send for Special Circular.

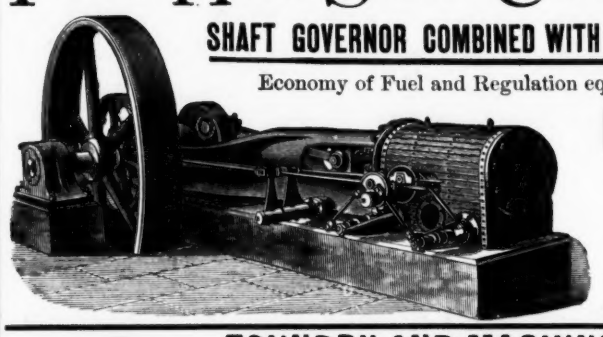


A GENUINE "CORLISS."

PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

Economy of Fuel and Regulation equal to anything in use.



B. W. PAYNE & SONS,

ELMIRA, N. Y.

45 Dey St., New York.

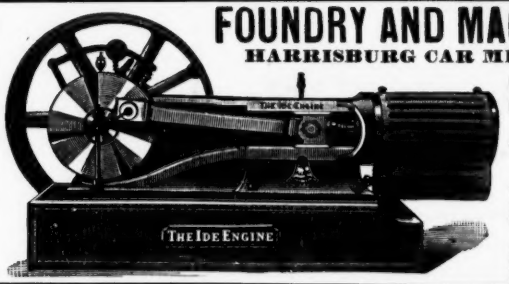
Hill, Clarke & Co.,

Boston, Mass.

10 S. Canal St., Chicago, Ill.

FOUNDRY AND MACHINE DEPARTMENT.

HARRISBURG CAR MFG. CO., HARRISBURG, PA.



Highest Award SILVER MEDAL and DIPLOMA

AT FRANKLIN INSTITUTE NOVELTY EXHIBITION, PHILADELPHIA.

We are operating the finest and most successful Electric Light Stations in the world. A change of speed not exceeding one per cent. guaranteed, running light and loaded. Send for catalogue.

New York Office, Fleming & Kimball, 17 Dey St. New England Office, John Post, Jr. & Co., 70 Kilby St., Boston. Baltimore Office, Thomas K. Carey & Bro., 35 Light St., Baltimore.

Corliss Engines

Of the highest type, in all sizes, are made by

The Lane & Bodley Co.

CINCINNATI, O.

The merits of their engines are described in an illustrated pamphlet, which will be sent to any one interested.

A BARGAIN.

1 No. 3 Brown & Sharpe Universal Milling Machine, with box of tools and lot of Extra Cutters, second-hand, good as new.

E. P. BULLARD,

62 College Place and 72 Warren St., NEW YORK.

C. H. DE LAMATER & CO.

have closed their extensive manufactory at the **Foot of West 13th Street, New York,** and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.

In order to close out the remainder of the stock, offer for sale

A Very Desirable Lot of Machinery,

such as lathes from 15" to 88" swing, planing machines 48"x45"x10', 53"x50"x12', 17"x14"x24', 72"x69"x24', and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers, and two 9"x16" and one 10"x30" Rider cut-off engines.

STEARNS M'F'G CO.

ERIE, PA.

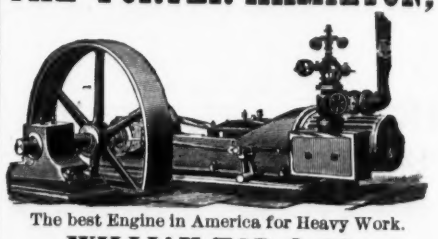
ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

SAW MILLS and GENERAL MACHINERY

NEW YORK STORE, 46 Cortlandt St.

THE PORTER-HAMILTON,



The best Engine in America for Heavy Work.

WILLIAM TOD & CO.,

Youngstown, Ohio.

CHANDLER & TAYLOR CO'S SELF-CONTAINED STEAM ENGINES

Are tested under full load before shipment.

12 TO 80 H. P.

IN STOCK FOR QUICK DELIVERY.

For Circulars address

CHANDLER & TAYLOR CO., INDIANAPOLIS, IND

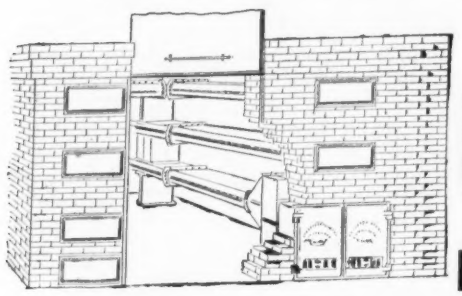
FOR SALE.

A valuable plant of machinery consisting of Milling Machines, Screw Machines, Engine Lathes, Drill Presses, Heavy Drops and Presses, &c., &c., also Tools, Belting and Factory Fixtures, formerly the property of the Howe Sewing Machine Co. Address

THE NEW HOWE MFG. CO.,
Bridgeport, Conn.

BROWN & SHARPE MFG. CO.

108 Promenade St., Providence, R. I.



IMPROVED

CORE OVENS.

Economical, Clean, Convenient.

S. A. SMITH,

Western Representative,

23 So. Canal Street, CHICAGO, ILLS.

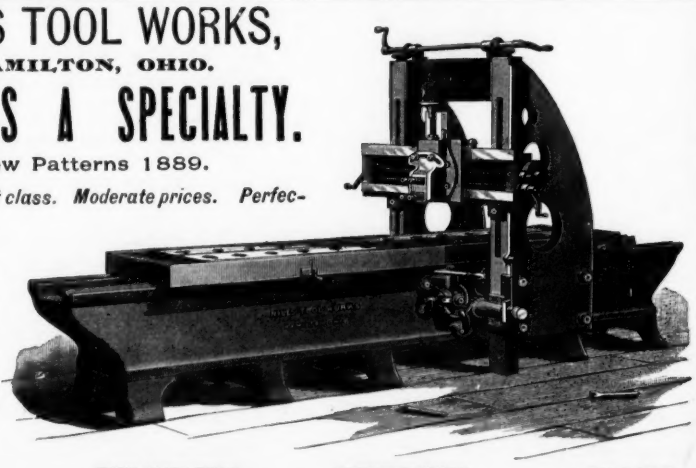
NILES TOOL WORKS,

HAMILTON, OHIO.

PLANERS A SPECIALTY.

New Patterns 1889.

Strictly first class. Moderate prices. Perfection of workmanship. Positive feed. Quick return. Extra heavy. Large bearings. The smoothest running Planers.



NEW YORK, 98 Liberty St. **PHILADELPHIA,** 705 Arch St. **PITTSBURGH,** Penn Building. **CHICAGO,** Phenix Building.

GRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN.
NEW YORK CHICAGO PHILA. BOSTON

The Original Unvulcanized Packing

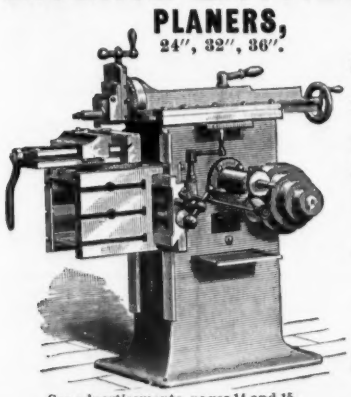
CALLED THE STANDARD—As it is the Packing by which all others are compared.

Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. { 71 JOHN STREET, N. Y. / 105 MILK STREET, BOSTON. / 21 NORTH FIFTH ST., PHILA. / 54 DEARBORN STREET, CHICAGO.

ENGINE LATHES, SHAPERS & DRILLS.

PLANERS, 24″, 32″, 36″.



MILLING MACHINES.

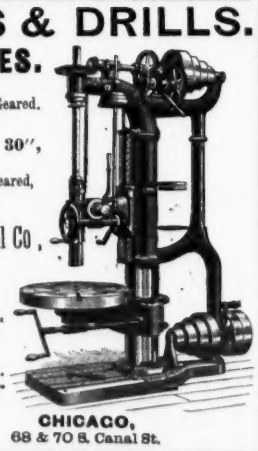
SHAPERS,
15″ and 20″ Crank, 20″, 26″, 32″ Geared.

ENGINE LATHES,
16″, 18″, 19″, 21″, 24″, 27″, 30″, 32″ & 38″.

20 inch Upright Drills. 25 inch Back Geared, and
24 " " "
28, 32 and 40 inch Power Feed Drills.

The Lodge & Davis Machine Tool Co,
Manufacturers of
IRON & BRASS WORKING MACHINERY.
WORKS, CINCINNATI, OHIO.

Write for prices: It will pay you. Special attention given to complete outfits.



NEW YORK, 64 Cortlandt St. **CHICAGO,** 68 & 70 S. Canal St.

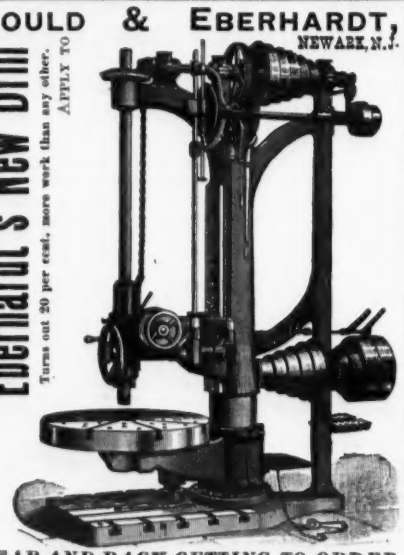
See advertisements, pages 14 and 15.

GOULD & EBERHARDT,

NEWARK, N.J.

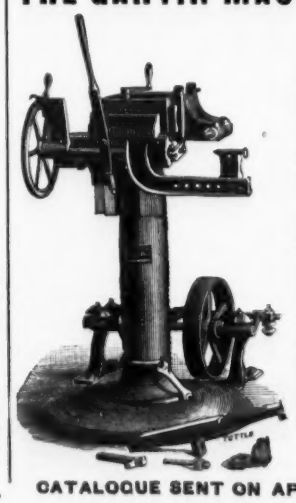
Eberhardt's New Drill

Turns out 20 per cent. more work than any other. APPLY TO



GEAR AND RACK CUTTING TO ORDER.

THE GARVIN MACHINE CO.



SMALL GEAR CUTTER.

This handy little machine is intended for rapid and convenient cutting of light gears, ratchets, etc., used in telegraphic and mathematical instruments, etc.

GEAR AND RACK CUTTING A SPECIALTY.
MANUFACTURERS AND DEALERS IN IRON-WORKING MACHINERY.
LAIGHT & CANAL STS., N. Y. CITY.

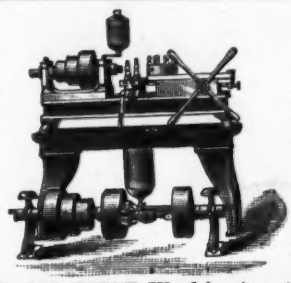
CATALOGUE SENT ON APPLICATION.

THE PRATT & WHITNEY CO.,

HARTFORD, Connecticut.

MANUFACTURE
HORIZONTAL
Boring Mills,

48 in. and 66 in. Swing.



Double Head Traverse Drills

For 5/8 in., 3 in. and smaller holes.

Revolving Head Drilling Machines.

WESTERN BRANCH, 100 WEST Washington Street, Chicago, Ills.

THE BILLINGS & SPENCER CO.,

HARTFORD, CONN., U. S. A.,

Manufacturers of

BILLINGS' PATENT
CUTTING-OFF TOOL.

The Holder is drop forged, of steel, and finished in a thorough manner. The Cutters are made of the best tool steel and furnished in the following thicknesses: 1/16, 3/32, 1/8, 5/32, 3/16, 7/32, 1/4.

Drop Forgings of Bronze, Copper, Steel and Iron of all descriptions.

WARNER & SWASEY,

CLEVELAND, OHIO,

MACHINE TOOLS

For Iron and Brass Work.

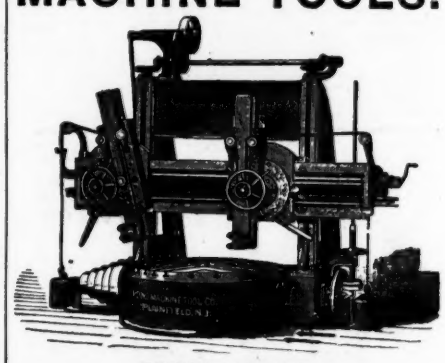
SMALL TOOLS & FIXTURES.

Gear Cutting in all its Branches.

ILLUSTRATED CATALOGUE ON APPLICATION.

THE POND MACHINE TOOL CO.,

Formerly of Worcester, Mass.
MANUFACTURERS OF
MACHINE TOOLS.



BORING MILLS.

Radial Drills, Planers, Lathes, Heavy & Powerful, from new patterns of the latest and best designs.

SALESROOM & OFFICE, 113 Liberty St., N. Y. City.
NEW SHOPS, PLAINFIELD, N. J.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. Swing. Circulars, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.

GEAR WHEELS AND GEAR CUTTING.

LEXINGTON GEAR WORKS, LEXINGTON, MASS.
BOSTON GEAR WORKS, 137 HIGH ST., BOSTON.
(GRANT) SEND FOR CATALOGUE.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.

J. M. ALLEN, President.
Wm. B. Franklin, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary & Treasurer.

Key-Seating Machines and 20 in. Drills

A SPECIALTY.

SEND FOR LIST OF

New and Second-Hand

Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.

W. P. DAVIS,
Rochester, N. Y
Works at North Bloomfield.

THE G. A. GRAY CO.

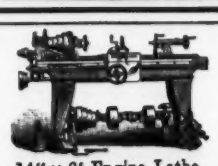
Cincinnati, Ohio.

PLANERS AND LATHES

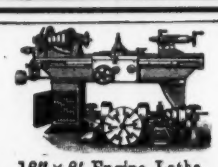
A SPECIALTY.

STEEL CASTINGS.

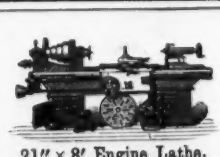
PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
BUFFALO, N. Y.



14″ × 6′ Engine Lathe.



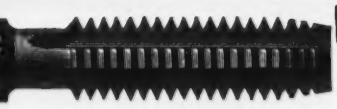
16″ × 6′ Engine Lathe.



21″ × 8′ Engine Lathe.

THE HENDEY MACHINE CO. SEND FOR OUR CATALOGUE. MANUFACTURERS OF MACHINE TOOLS TORRINGTON CONN.

J. M. CARPENTER PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES